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Pratt & Whitney Gear Tooth Grinding Machine

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A machine built around an idea—Faces of grinding wheels represent tooth profiles of rack—An ingenious adaptation of a mechanical movement—A true generating machine

As an incentive to the study of mechanical problems and to the consistent progress of development toward perfection of detail, not alone in accuracy of workmanship but in strength and adaptation of materials, in the conception of ingenious mechanisms, in the concentration of design and in the remarkable advance in processes of production, the automobile easily takes precedence over any single invention within the realms of mechanics.

To few of the parts that go to make up an automobile has the research engineer contributed more of his attention than to the gears through which the power of the motor is applied. These gears are called upon to carry heavier loads in proportion to their size than almost any other form of gearing, and in their regular service are subjected to conditions that none but the most carefully calculated and accurately made gears would be able to withstand.

It is necessary that such gears be hardened, but the hardening process causes distortion, and the effect of distortion is noise. The ideal transmission gear is one upon which the tooth profiles have been ground to shape after hardening, so that not only are the evil effects of distortion counteracted but slight errors in cutting are eliminated as well.

The grinding of such gears is by no means impracticable and in many of the better cars ground gears are used in the transmissions, but this grinding is looked upon as a comparatively slow operation, adding its burden of expense to production, and it is not practiced so generally as it otherwise would be. The purpose of this article is to set forth a new conception in the art of gear grinding and to describe an ingenious machine that has been built around the idea.

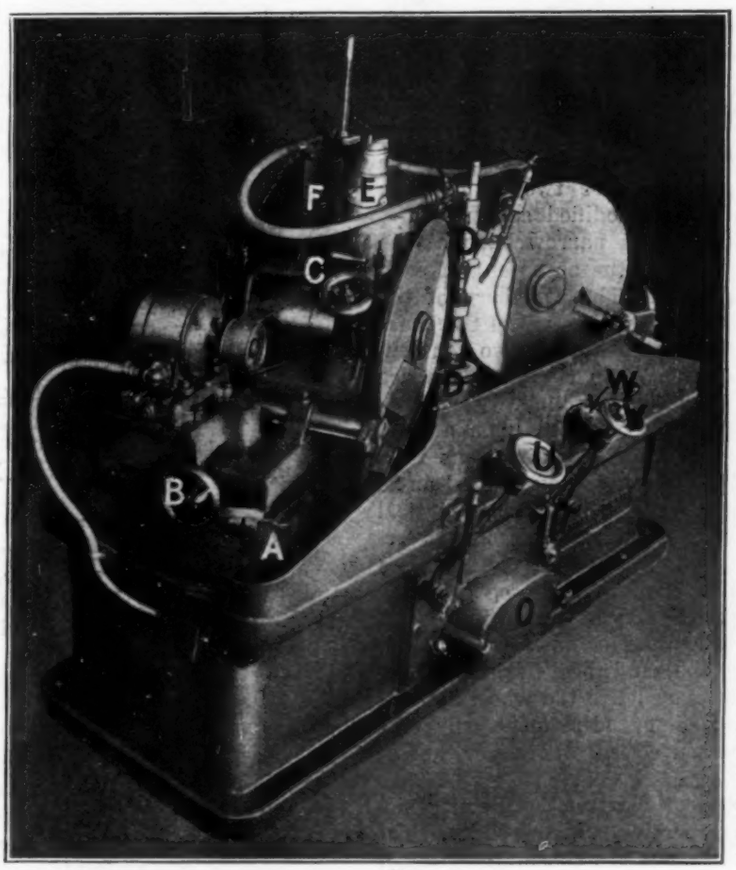
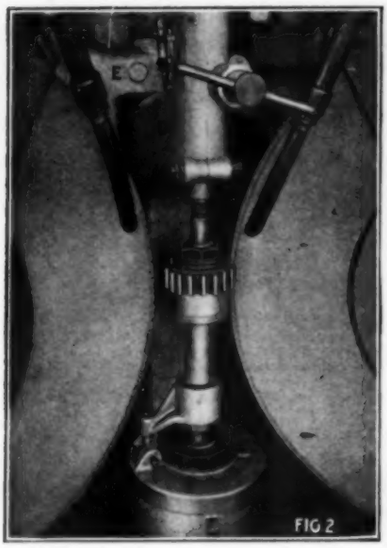


FIG. 1—THE PRATT & WHITNEY GEAR GRINDING MACHINE

The premises upon which the conception is based are: First, that the high degree of accuracy of tooth contour necessary to the quiet performance of gears running at high speeds under heavy loads can most certainly be attained by the continued application of very light grinding cuts rather than by a lesser number of proportionately heavier cuts, because of the reduced tendency of possible original errors to persist by reason of the inevitable "spring" of the grinding

wheel, work and work carrying mechanism, as well as because of the wider distribution and consequent reduction of error due to wheel wear; and second, that in order to reach a satisfactory rate of production by this means the cuts must be made in extraordinary rapid succession and with unerring precision. To whichever part it is applied—wheel or work—the movement must



FIGS. 2 AND 3—OPPOSITE POSITIONS OF THE WORK

be continuous, without reversal of direction or appreciable pause for indexing.

How simple, and yet how complete, has been the solution of the apparently prohibitive mechanical difficulties involved, may be discerned in the following description of the rotary gear-tooth grinding machine developed by the Pratt & Whitney Co., New York, N. Y., from a conception based upon the above premises.

In Fig. 1 is shown the general appearance of the machine. The grinding wheels are two in number, 24 in. in diameter, and of a modified saucer shape. The active grinding surface is a narrow band at the edge of the outer side (nearest the observer) of each wheel, and is a plane surface. The periphery of the wheel does not touch the work and the wheel thickness is somewhat less than the space between two consecutive teeth of the gear, so that only the plane surface referred to touches the gear being ground.

Each wheel is independently mounted upon a head that is capable of adjustment in two directions in a horizontal plane, and of swiveling to any desired angle within the limitations required by the various practical pressure angles of gears. A graduated arc and vernier reading to minutes are provided at *A** to facilitate the angular setting. The primary slide, operated by a screw and the handwheel *B*, may be moved in a direction at right angles to the wheel spindle, and the secondary slide, operated by the handwheel *C*, provides for adjustment in a direction parallel to the wheel spindle. All of these movements are for adjustment only; the wheels in action have no movement other than that of rotation.

The wheels are independently driven by electric motors mounted upon the respective primary slides. The pulleys upon the wheel spindles are considerably wider of face than the driving belts, so that adjustment of the secondary slides will not disturb their alignment.

The gear to be ground is held, with its axis vertical, between centers that are carried by the frame *D*, which is so suspended from the column of the machine that, while the line of its work centers is rigidly confined to parallel positions, it cannot move vertically, but is otherwise free to move in any direction. The restraining influences which confine the movement of the gear to an arbitrary path are within the base of the machine below the frame.

In Figs. 2 and 3 are shown two opposite positions of the work, Fig. 2 showing the gear as it is receding from the point of observation and rolling a tooth profile over the face of the grinding wheel to the right, exactly as if the latter were the tooth of a rack. Fig. 3 shows the same gear coming forward after the machine has passed through one-half of its cycle, and rolling the opposite profile of a different tooth in a similar manner over the wheel to the left.

The Swinging Work Carrier

In these two figures the letter *D* indicates the first member of the movable frame, which is supported by ball bearings at top and bottom of the secondary member *E*, the latter being swung in a similar way from a bracket on the column of the machine. This bracket, which may be seen at *F* in Fig. 1, has a vertical movement for convenience of assembly only, but does not move during the operation of the machine.

In Fig. 4 is a view of the machine from about the same point of observation as in the preceding illustration; but with the grinding wheels separated by running back their respective slides, and the work head raised about 8 in. for the purpose of making the necessary changes to adapt the machine to the grinding of a different sized gear. The position of the upper end of the work spindle is indicated by the letter *G*, which part is a circular driving plate screwed to the spindle, and which also acts as a guard to prevent water and abrasive dust from working into the bearings.

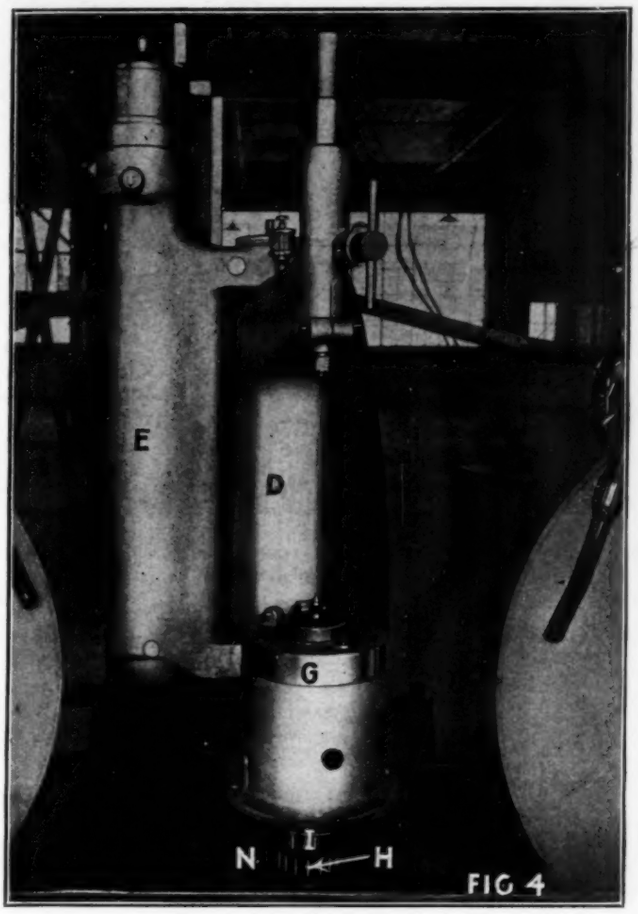
At *H* and *I* may be seen, respectively, the master-gear and the guide bearing or roller, which, with the toothed track *J* and smooth track *K*, Fig. 5, are the elements that define the arbitrary path in which the work must travel. All of these parts (which are in effect but two, as *H* and *I* are mounted as one unit, while *J* and *K* are similarly united as another unit) must correspond to the characteristics of the gear to be ground, and are therefore changed each time the machine is changed from one size of gear to another.

The Feeding Movement

The casting *L*, Fig. 5, is called the "feed slide." It is not, strictly speaking, a slide, although it has a slight movement forward and back under control of a feed cam within the base. Instead of sliding on bearings it is supported by three heavy flat springs, placed in a vertical position, and its movement of $\frac{1}{16}$ in. is by flexure of these springs.

The upper surface of the slide is level and its position in the machine is directly under the master-gear *H*, as shown in Fig. 4. All parts shown in Fig. 5 are in working position except frame *D*, which is raised and swung to one side. To the master-gear is fastened the frame *M*, containing the toothed track *J* and smooth track *K* which, once their final position is determined, become permanently a part of the frame. To change

*Each individual reference letter used in this description indicates its respective part of the machine without regard to the number of the figure in which it may appear.



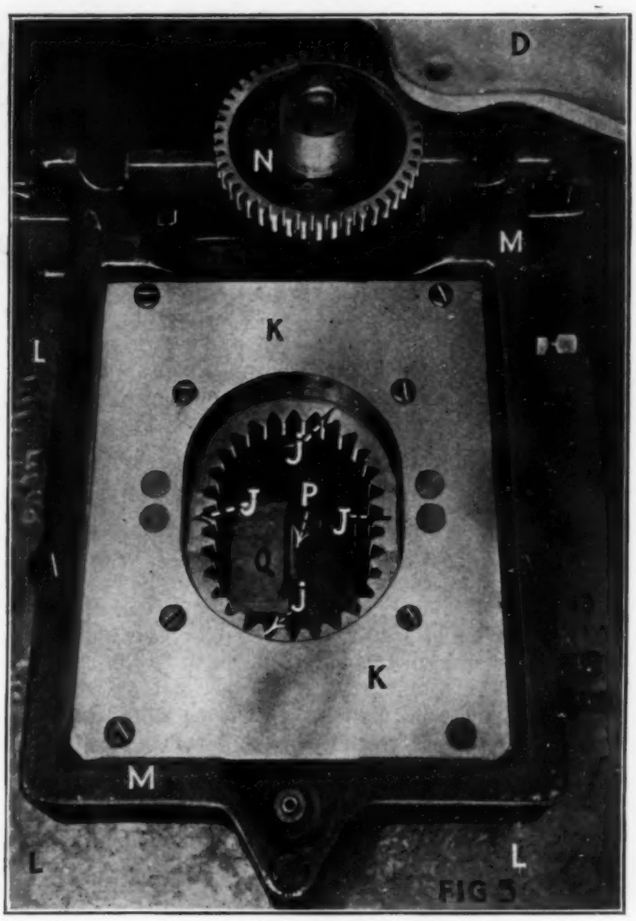
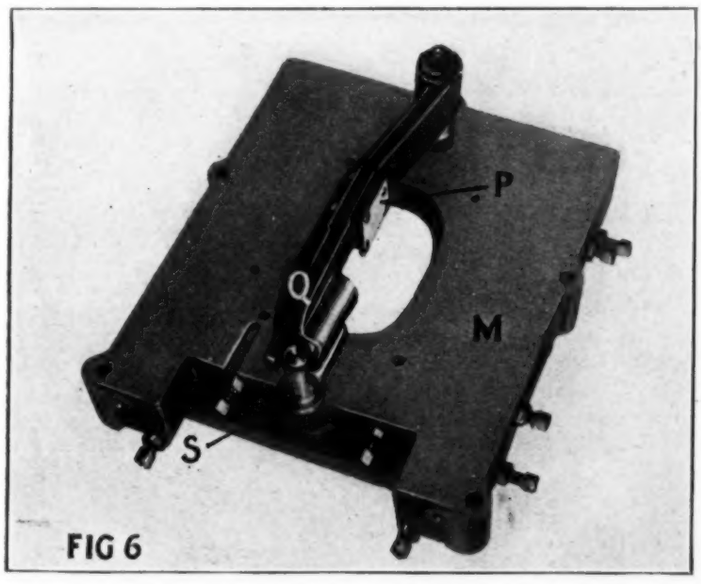


FIG. 4—FRAME LIFTED FOR CHANGING OVER THE MACHINE. FIG. 5—CONTROLLING UNIT AND DRIVING GEAR

these parts for others when resetting the machine, it is necessary only to draw the fillister-head screws that hold the frame and to lift the latter off the key that locates it on the slide.

It must be understood that the frame *D* is in no way attached to the feed slide *L*. The master-gear *H* and guide bearing *I* are within the opening formed by the parts *J* and *K* when the machine is assembled in operating position, and these parts therefore confine the movement of the free end of the frame to their own shape and limits. As the feed slide is moved forward or back the outer end of the frame must, perforce, follow it; but this does not interfere with the movement of the frame as the master-gear rolls in its orbit.



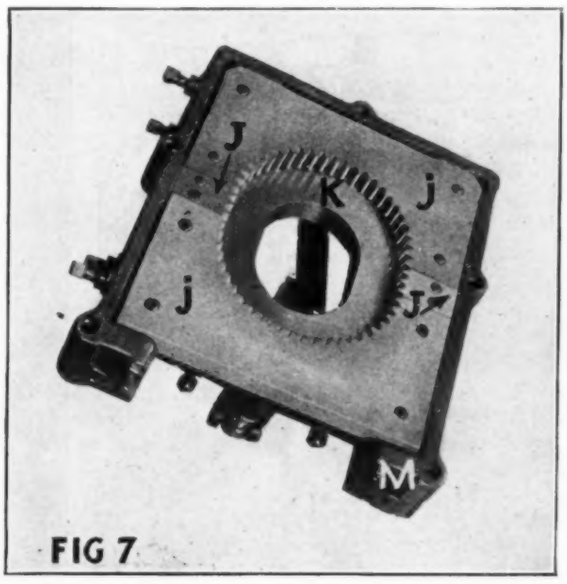


FIG. 6—UNDER SIDE OF CONTROLLING UNIT. FIG. 7—FACE OF CONTROLLING UNIT (REMOVED FROM MACHINE)

The gear *N* is keyed to the upper end of a shaft in which there is a universal joint, so that the gear, while rotating, is free to move a limited distance in any direction in a horizontal plane. A stud in the under side of the frame fits into the bronze bushing of the gear and thus constrains the latter to follow its movements. Gear *N* meshes with an intermediate gear, also running upon a stud in the underside of the frame, and that gear in turn with a gear that is keyed to the work spindle above the master-gear. Gear *N* is thus the driving element, receiving its power through the universal jointed shaft from a separate motor located in the rear of the machine base and transmitting it through the intermediate to the master-gear *H*, which is at once the cause and the controlling influence of the rolling motion of the work.

Construction of the Tracks

The smooth track *K* has the appearance of being an ellipse but is not so in fact, its contour being oblate rather than elliptical. The toothed track *J*, to the shape of which *K* must conform, is made up of the four separate pieces *J J* and *j j*, of which *J J* are straight racks and *j j* the halves of a truly circular internal gear, separated from each other by the length of the racks.

Parts *J J* lie parallel to each other, and are made as nearly to theoretical perfection as is possible to accomplish. Accuracy of tooth form in parts *j j* is a minor consideration, as the work does not contact with the grinding wheels while the master-gear is engaged with them, but the number of teeth in each is of vital importance.

The number of teeth in the master-gear must bear a definite *aliquant* relation to the total number in the toothed track; that is, the relative number of teeth must be such that a given tooth of the master-gear will not again enter the *same* tooth of either rack *J J* until the machine has completed a number of cycles equal to the number of teeth in the gear to be ground.

With the above conditions in mind, together with a knowledge of the functions of the various parts, we can now trace the action of the machine.

As the master-gear *H* travels around its oblate path, the gear to be ground rolls in harmony with it around a similar, but imaginary, path upon a level with the centers of the grinding wheels. As the master-gear rolls over either of the rack sections *J J* the gear above it rolls over a very real rack tooth projecting into its imaginary path—which rack tooth is the active surface of one or other of the grinding wheels.

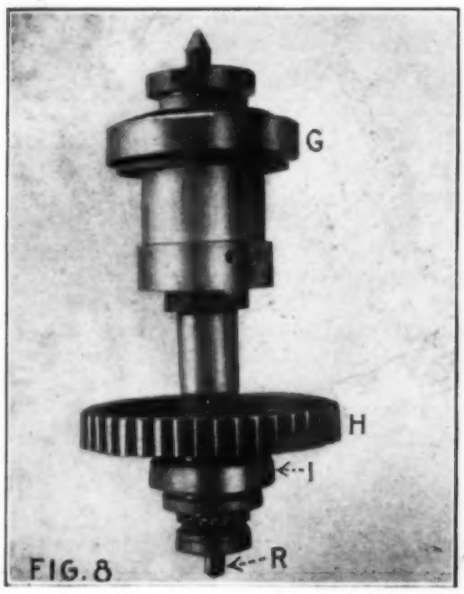
As the total number of teeth in the track is necessarily greater than the number of teeth in the master-gear, the first impression is that the latter in passing through one cycle must have made more than one complete revolution about its axis. As a matter of fact it has not done so, for the reason that while it is rotating in a clockwise direction about its own axis, the axis is being carried around the orbit in a counter-clockwise direction, and one full revolution of the gear in each cycle has been nullified, or cancelled, by this reverse movement. The actual forward rotation of the gear in any one cycle is, therefore, equal to the difference between the numbers of teeth in the master-gear and the track.

This differential progress constitutes the indexing movement. There is no pause or hesitation in either the continuous clockwise rotation of the gear or in the counter-clockwise rolling of the parts around the orbit; yet the grinding wheels cannot possibly come a second time in contact with any given tooth of the gear until all the teeth have passed once over them.

Indexing and Feeding the Work

What has been said of one grinding wheel is, of course, equally applicable to the other. The second wheel grinds the opposite profiles of the teeth as the master-gear rolls over the corresponding rack, and therefore both sides of every tooth have been ground once when the number of cycles has equalled the number of teeth in the gear.

At the beginning of the operation the feed-slide is in such position that neither grinding wheel touches the work. As the slide slowly and continuously advances under the action of the feeding cam, the teeth of the gear are brought into contact with the grinding wheels. This feeding movement continues until the gear is ground approximately to size. The grinding, however, continues after the feed has stopped until sufficient



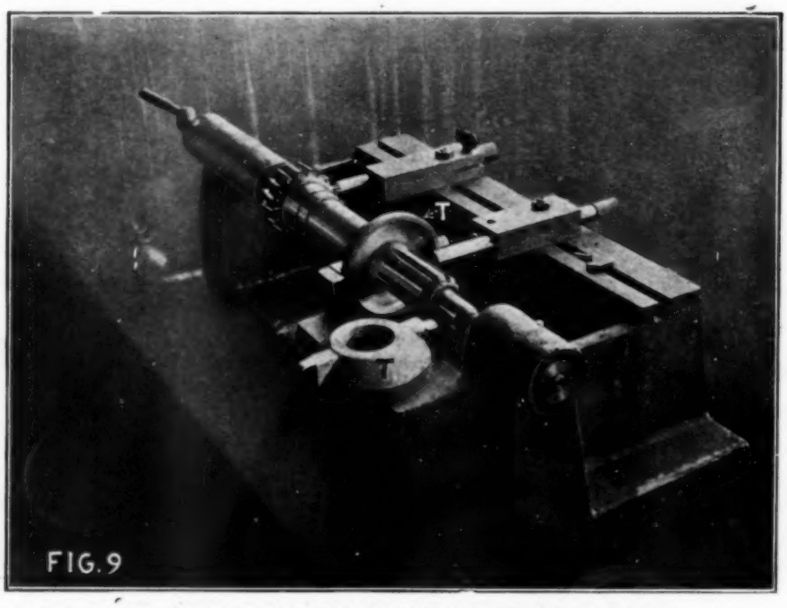


FIG. 8—WORK SPINDLE, MASTER-GEAR AND GUIDE BEARING. FIG. 9—WORK SETTING DEVICE

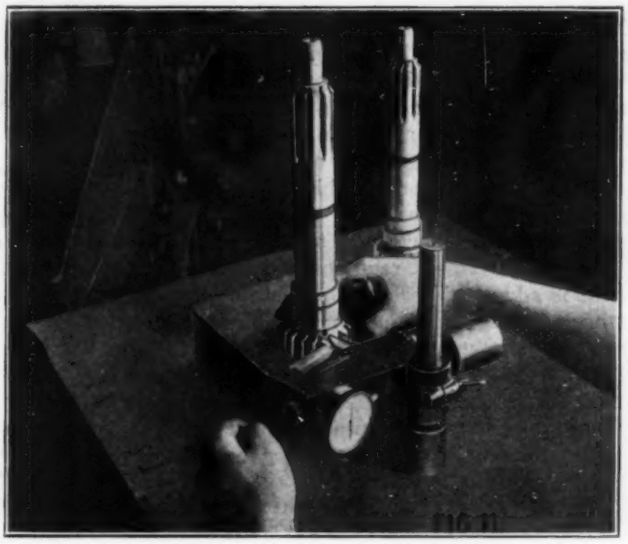


FIG. 10—DRESSING THE GRINDING WHEELS. FIG. 11—MEASURING THE NORMAL PITCH WITH THE ODONTOMETER

"spring" has been ground out to bring the gear to the desired accuracy, as is common to all precision grinding operations. A small amount of stock is, of course, removed after the feeding movement is stopped, but it is removed in very minute quantities.

To take a concrete example: Let us assume the machine running at the rate of 150 cuts per minute, the feed being 0.0004 in. per cut and the stock to be removed 0.004 in. At this rate ten cuts per tooth will remove the stock and ten cuts more per tooth will be sufficient to remove the "spring." A total of 20 cuts per tooth at the rate of 150 cuts per minute gives a time of 7.5 seconds per tooth. The number of cuts per minute is variable by means of change gears in the gear box *O*, Fig. 1, on the front of the machine. It should be noted in addition that the master-gear and toothed track also act as change gears.

Contact between the smooth track *K* and the guide bearing *I* provides a few thousandths of an inch backlash between master-gear *H* and toothed track *J*. This contact is maintained by the parts *P* and *Q* in Figs. 5, 6 and 7. The two latter figures show a complete unit removed from the machine and compare with *J*, *K* and *M* in Fig. 5, but for a different sized gear.

In Fig. 8 may be seen the work spindle with its master-gear and guide bearing belonging with the unit shown in Figs. 6 and 7. It will be noticed that in this unit the relative positions of parts *J* and *K* (and, of necessity, parts *H* and *I*, Fig. 8) are reversed; but this arrangement is for convenience only and does not affect the principle. In order to be able to raise the frame and draw the master-gear and guide bearing out of the controlling unit the larger of each of these two members must be uppermost.

How the Work Spindle Is Guided

At the lower end of the work spindle in Fig. 8 is a small guide bearing *R* which, when the machine is assembled in working position, travels around the contour of the projection *P*, Figs. 5 and 6. The size and shape of the projection is so calculated that when the small guide bearing *R* is in contact with it, the larger guide bearing *I* is also in contact with the smooth track *K* on which it rolls.

Part *Q*, Figs. 5 and 6, is pivoted at its rear end to the under side of the unit, and has at its forward end a spring-actuated plunger which contacts with the fixed stud *S*. By this construction the bar *Q* is forced towards the central position, but is moved slightly to one side or the other by the pressure of the small guide bearing *R* just mentioned.

Fully Protected Against False Movements

To one observing the machine in action for the first time a smash-up seems inevitable. When watching the gear dodging in and out between the rapidly revolving and fragile appearing grinding wheels so fast that its movements can hardly be followed by the eye, the impression is gained that sooner or later a tooth is going to land on top of one or other of the wheels.

As a matter of fact, a smash-up is impossible. The grinding wheels have no movement other than that of rotation, and the master track has but a slight movement relative to them. The relative positions of the work are accurately determined and rigidly maintained by the steel walls of the controlling unit. It is necessary only to make certain that every piece set into the machine bears exactly the same circumferential relation to the master-gear, and that condition is determined by the setting fixture shown in Fig. 9. Two driving arbors *T* are used, so that the operator may be setting one piece while the machine, which is automatic in its movements, is grinding another.

Having set the work and driving dog on the arbor in proper relation by means of the fixture, the operator places the work on the centers, turns the machine slowly by means of the handwheel U, Fig. 1, until the work has passed both wheels once and proved that he has made no error in the setting, and then he throws on the power.

The handwheel *V* is on the shaft that turns the feed cam. The latter is a peripheral disk cam having a slow rise, a dwell and a quick drop to starting position. It is worm driven from the same motor that rotates the work, may be stopped and started by a clutch or turned back by hand at will, and when it has made one complete turn the grinding operation is finished. The dial *W* is graduated to show in thousandths of an inch the advance of the feed slide.

The device for redressing the wheels is shown in

Fig. 10. The diamond is set in the end of the small round holder that is driven transversely into part *X*, which is a hardened and ground steel parallel. It is not attached to the machine in any way. The rest is attached to the primary slide and moved with it, but its position is not affected by adjustment of the secondary slide. It is, however, capable of adjustment in the same direction as the secondary slide, but it is seldom necessary (never in operating) to use this adjustment.

When the wheel requires redressing, the secondary slide is advanced perhaps 0.001 in. by means of its handwheel *C*, Fig. 1. The amount of this advance is not material, except that it be sufficient to insure a true face after the wheel is redressed.

The operator then takes up the dresser and lays it upon the rest with the pinion of the hand lever in mesh with the rack, and passes the diamond across the face of the wheel by means of the lever. The position of the dresser on the rest is determined by two hardened steel pins, and when the diamond has ceased to cut, the operator knows that the face of the wheel is in its original position. Dressing is done while the first roughing cuts are being taken, so that no time is lost.

In any gear grinding operation it is necessary to keep a constant watch upon the accuracy of the product, and this is here done by means of the Odontometer shown in Fig. 11 and designed to measure the normal pitch of gears. With this instrument it is possible to detect a departure from true normal pitch to a limit of accuracy of 0.0001 in., by bringing each tooth successively in contact with the measuring points and noting the error upon the dial.

Qualities of the Successful Employment Manager

By W. E. Richmond

IT DOESN'T matter what your job is, there are always a number of things connected with it which give you a chance to use any native intelligence you have, in handling it well. It is not, of course, the soft job that brings out all that is in you, yet an employment manager could well dispense with some of the handicaps connected with his work, the overcoming of which take time and effort which could be expended to better advantage.

The successful employment manager must study and classify correctly not only the needs and wants of the plant as a whole, but the whims and preferences of each individual, from foreman to manager, who has anything to say about the type of employee he desires.

Theoretically, the employment manager hires, trains, promotes and discharges all employees, functioning in this capacity to fully co-operate with all department managers so as to produce as nearly perfect a personnel as the environment in which the plant is situated will permit.

Practically, the building up and maintaining of a nearly perfect personnel organization requires not only full co-operation of the employment manager with the superintendents, but the manager must have from each of them individually, and all of them collectively, all the support they are capable of rendering. Here enters the personal element. Each boss, from foreman to general manager has his whims, idiosyncrasies, preferences and ideas, all more or less fixed, which he will not or cannot change when it comes to co-operating with some one else. So, the employment manager must exercise a nimble wit when, for the bests interests of all concerned, he knows that it is desirable or necessary to get around some of these corners.

The employment manager cannot be sentimental—these other chaps as a rule have not wholly learned that they should not be sentimental. Some one's prejudices against red or bobbed hair, the excessive use of a vanity case, too high heels on her slippers, and a thousand and one such little details have often kept deserving girls from landing in good positions, but, the point is here, the girl chosen because of some superficial favorable characteristics was not, from the standpoint of efficiency, necessarily the right one.

One foreman can dig more ditch with Mexican labor, others with Italian, Greek, or white. Another will use anything but a Swede or an Irishman, while still others want all of them they can get. A chief engineer of my acquaintance frankly states that he "hates railroad engineers," yet I never have persuaded him to tell why.

Then there is the superintendent that is sure that the last man he sees is the best one. He always regrets having made a choice, as he is sure that the present applicant is a better one.

Personal likes and dislikes, within reason, must not influence a superintendent who is after results. If of the type that is so influenced, he must learn to rely on the judgment of the employment manager as superior to his own. This is a hard dose for some to swallow, but they have been known to do it. Within the limits of the policy of a firm a man must be measured by what he accomplishes, not by whether we like him or dislike him. Overlooking bad qualities because of one good quality, and the reverse, is not profitable if no effort at correction is made.

Give the Capable Assistant a Chance

Here and there may still be found a foreman who will try to prevent you from hiring an assistant for him who is so good that he may work the foreman out of his job. Such cases confirm my statement that an employment manager must remove the word "sentiment" from his vocabulary.

There is one type of man in positions of more or less authority who hates or dislikes others who may be under or over him, because they know more about some things than he does. A slight change in his point of view will cause him to realize that he knows a lot that they do not, and that he can make it his business to learn anything that they know if it is desirable to add that knowledge to his fund. Then he can learn to like instead of hate his fellow workers, because they prod him into increasing his own value.

As it is more fully realized how indulgence in personal sentimental whims and fancies on the part of superindents "gums up" the smooth working of personnel management and directly adds to the already too high general cost of labor turnover, this expensive pastime will decrease in popular favor. When all is said and done, the whole effort of the employment manager today is, always within his limits, to make the entire personnel function as smoothly as the latest and very best engineering practice keeps the plant machinery running.

Development of Machine Tools in New England

BY GUY HUBBARD

The seventh article—Early gun making by the interchangeable system—Special machinery and tools brought out by the contract method—Payments made in land

IN 1835, Nicanor Kendall, a young gunsmith, became a son-in-law of Asahel Hubbard and was taken into the National Hydraulic Co. At this point there began with this concern, the second and a most important phase of the machine industry at Windsor—the quantity manufacture of firearms. The National Hydraulic Co. continued under the original name until 1839, when Asahel Hubbard sold out his entire interests to Mr. Kendall and moved "way out west" to Iowa—as numerous other Vermonters were doing at that time.

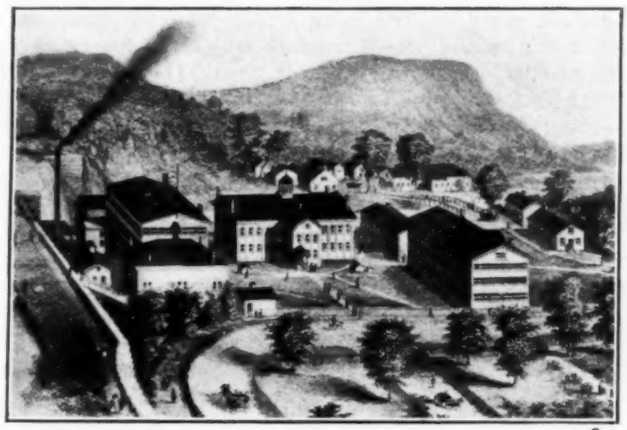


FIG. 37—ELI WHITNEY'S ARMORY, WHITNEYVILLE, CONN. (From a steel engraving made about the time of the civil war)

It appears that during his visit to that territory in 1831, on his "St. Louis horse," the inventor had invested his share of the cash proceeds of the St. Louis pumps in a "quarter section," at Davenport—which town was very attractive to him. In 1840 he settled permanently upon this quarter section and continued to exercise his engineering tastes, as well as his undoubted love of adventure, by becoming a surveyor of government land in Iowa. In the performance of this work, this pioneer mechanic met a rather untimely end on September 18, 1845. He died of fever in his surveyor's camp in the wilds of Mahaska County, Iowa, more than a hundred and fifty miles from a human habitation. His body was carried to Davenport by his Indian guides, eventually being buried at Windsor within sound of the wheels of the industries which he set turning.

Before emigrating to the West the inventor sold the patent rights of his pump in Connecticut to Ezra Williams of Deep River, who manufactured them there in small sizes for more than twenty years. The site and water power of this Deep River pump factory is now occupied by the Pratt & Reid Ivory Co. which is the leading industry of that ancient tide-water town.

The inventor's son, Colman S. Hubbard, (1816-1877) who has been mentioned as his father's assistant and the foreman of the pump shop at Windsor, went to Deep River at the time of this sale in order to set up the pump manufactory for Mr. Williams. He later became a skilled gun maker and from 1860 to 1865 served as Secretary of the Whitney Arms Co. at Whitneyville, Conn. (Eli Whitney's Armory, see Fig 37) under Eli Whitney, Jr., who, during the civil war, was one of the most prominent manufacturers of rifles for the Government.

It may be mentioned that the revolving hydraulic engine, besides being continued by the Fales & Jenks Machine Co. in its original form, is familiar to all of us as the common rotary gear pump so universally used in the cooling and oiling systems of automobiles and for circulating the cutting compound and oil on machine tools. See Fig. 38.

For the latter purpose those modern machine tool industries at Windsor and Springfield, Vt., which are direct descendants of the National Hydraulic Co., have of late years manufactured literally thousands of the rotary pumps, so indirectly the original industry is still very much alive in the very region where it came into being but little short of a century ago.

Nicanor Kendall, whose portrait is shown in Fig. 39,

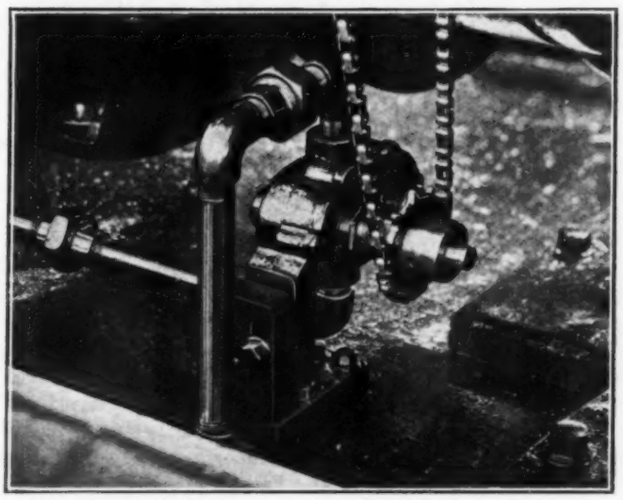


FIG. 38—THE OIL PUMP ON MACHINE TOOLS IS ESSENTIALLY THE REVOLVING HYDRAULIC ENGINE

was born in the West Parish, now called West Windsor, December 20, 1807—the son of the village blacksmith. Working in his father's shop after hours while he attended the district school, he learned the trades of blacksmith and wheelwright, which in country villages were closely allied. Being dissatisfied with this rough sort of work, "Cain" or "N." Kendall, as he was generally called, perfected his practical knowledge of the mechanic arts as an assistant in the shop of Asa Story, the gunsmith of the West Parish, who was engaged in building turkey and squirrel rifles on the Kentucky pattern to suit the needs of the farmers thereabout. He was called a custom gunsmith, just as tailors are called custom tailors today, for in those days expensive sporting rifles were "tailored to fit"—each careful marksman demanding his own special shape of stock, length and weight of barrel and twist of rifling.

During the latter part of the time when Asahel Hubbard was operating his shop between Windsor and the West Parish, Nicanor Kendall became, for certain reasons, a frequent visitor there. One day when this young gunsmith and the daughter of the house were riding in a sleigh along one of the country roads, he noticed a gray squirrel in a tree nearby and having one of Story's side hammer percussion rifles with him, he started to draw it from beneath the buffalo robe. As he did so the hammer caught, and falling, exploded the charge when the muzzle was in his hand and apparently pointed directly at the young lady's head. Believing his right hand to be blown to pieces, Kendall thrust it under the robe and, horror stricken, turned to see what the fate of his companion had been. To his intense relief he found that at the moment of the explosion she had chanced to lean out of the sleigh to look back so, aside from being badly frightened, was uninjured. Without mentioning his own crippled condition Kendall drove hurriedly to the house of the village doctor, where he was further gratified to find that his hand, instead of being shattered was only burned, the ball having passed between his fingers.

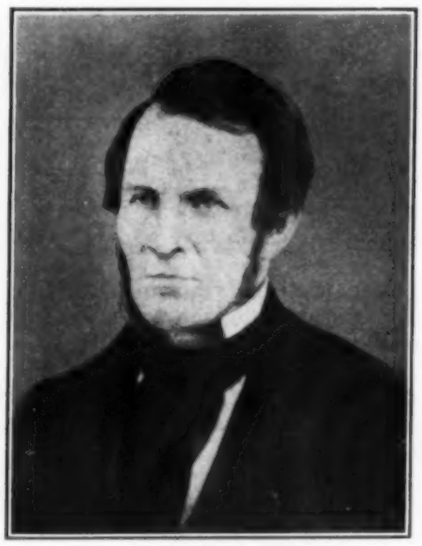


FIG. 39—NICANOR KENDALL
(From an old photograph)

This accident inspired Mr. Kendall to invent a type of gun lock in which the trigger and hammer might be protected by the same guard. The result of his efforts in this direction was one of the cheapest, simplest, and most dependable locks ever devised. The mechanism, generally called "Kendall's patent underhammer lock" was eventually adopted as the standard type by all the custom gun makers of the Windsor district, including Asa Story, and is one of the "ear marks" of the thousands of percussion sporting arms manufactured in that district between 1835 and 1880.

FIG. 40—ORDINARY MUSKET LOCK

As the name suggests, the Kendall underhammer gun had the hammer beneath the barrel. This location, in front of the trigger, was originally chosen for the reason mentioned above, but the guard over the hammer was later on eliminated. The outstanding advantages of this lock are: that it is a unit with the breech block or "breech pin," thus doing away with the lock plate and its recess in the stock, which greatly simplifies the stocking of the rifle; that the top of the barrel is left clear for sighting and there is no danger of the shooter flinching from the sight of the falling of the hammer, or from fire from the cap; that the barrel is of the simplest possible form, being a plain tube with the cone screwed directly into it, through which the fire reaches the powder charge directly. It used to be a saying of the muzzle-loading gun that it consisted of but three parts, "lock, stock, and barrel" but in the standard side hammer type the lock, Fig. 40, was made up of no less than fourteen complicated pieces in all of which high accuracy was essential. As compared to this, the Kendall lock, Fig. 41, consisted of but seven simple parts, in none of which great accuracy was essential even under the interchangeable system. This made it possible for the country gunsmiths, with their small shops and crude tools, to compete with the large manufacturers as long as the percussion system was in use.

Manufacture of Underhammer Guns

Soon after his marriage in 1835, Nicanor Kendall went to work with the National Hydraulic Co. and interested his father-in-law, Asahel Hubbard, in the manufacture of the underhammer guns. Like the earlier productions of Asa Story, these rifles were patterned after the Kentucky models, which were small bore rifles of the Arabic style, very popular among backwoodsmen. The main departure from the Kentucky type was that the Kendall rifles, on account of the new lock, were

FIG. 41—KENDALL'S UNDERHAMMER LOCK
(Showing the Lawrence Peep Sight)

stocked only at the breech. The interchangeable manufacture of these arms was begun at Windsor on the "contract system," in the pump factory at the Vermont State Prison, by Kendall, Hubbard & Smith, Contractors, who made all the parts themselves with the exception of the barrels. The barrels, which were beyond the capabilities of their mechanical equipment, were forged, bored and rifled to specifications by Eliphalet Remington, whose portrait is shown in Fig. 42, a skilled gunsmith of Ilion, N. Y., from whose humble shop, Fig. 43, was destined to develop two industries which are today known the world over—The Remington Arms Co. and the Remington Typewriter Co. The Kendall rifles were sold through the already established agents of the Hydraulic Co. by which means wide distribution of the new firearm was immediately attained.

Because of the fact that both gunsmiths and the contract system are here mentioned for the first time and as both these craftsmen and this system had a profound influence upon American manufacturing, a word of explanation will not be out of place at this point.

FIG. 42—ELIPHALET REMINGTON, MAKER OF FIRST REMINGTON RIFLE

The gunsmiths developed from the ancient armorers, whose craft has been defined as a refined branch of blacksmithing. As the name suggests, the early gunsmiths were closely allied to the blacksmiths—they were in fact blacksmiths until well after the beginning of the 19th century. Old time firearms were built of high-grade hand forgings, which were dressed by filing to fit together and it was not until the development of the interchangeable system in America by Eli Whitney, that the gunsmith actually ceased to be a smith in the true sense of the word.

The interchangeable system was developed for the purpose of manufacturing army muskets, which were the first high grade mechanisms required in quantities and exactly alike. It was for the purpose of manufacturing such guns that the distinct improvement in machine tools and in machine shop systems was initiated in America. Thus it came about that instruments primarily designed for destruction brought about the great constructive movement, called by Henry Rowland in the *Engineering Magazine* of 1899, "the revolution in machine shop practice." As will be shown later on, this gun manufacture gave industrial supremacy to America and did so without the shedding of a drop of blood, for in the evolution of industry in New England, "swords were beaten into plowshares," in effect if not to the letter.

Under the interchangeable system, the gunsmith became a high grade machinist similar to our toolmakers of today and as soon as the development of this system resulted in the detailing of one step of the process to each workman, (the Subdivision of Labor it is called in Economics) the less skilled and even the unskilled were employed upon details under the direction of a gunsmith, who was thus able to enlarge his sphere of usefulness tremendously.

In the larger New England shops it soon became the custom for the experienced gunsmiths who were in charge of such organized groups of workmen, to take contracts for the production of large lots of certain parts of guns, (such as the locks, or some part thereof) the company furnishing shop room, heat, light, power, material and standard tools, while the contractor himself furnished and paid for the labor, superintended the work and devised and built his own special tools and oftentimes special machinery. Under this system it is evident that the quicker and more cheaply the contractor could do his work and still have it pass inspection, the more money he made and this was naturally a powerful incentive to the invention of improved tools, jigs, fixtures and methods, as well as to the cultivation of keen business and executive ability among the contractors. Therefore, not only did numerous improved machines come into being as a direct result of this system but also numerous industrial leaders began their careers as contractors in the old New England shops. The early introduction of the contract system at Windsor, will in some measure account for the numerous vigorous industrial offshoots therefrom.

In November, 1835, the American settlers in the territory of Texas organized as the "Lone Star Republic" and in consequence found themselves at war with the Republic of Mexico, which claimed sovereignty over them. These Texas patriots, who in common with other frontiersmen were devotees of the small bore Kentucky rifles, were in immediate need of quantities of such accurate firearms at the lowest possible price. Through its agents in New Orleans, the National Hydraulic Co. learned of this condition and being by that time organ-

Courtesy Remington Arms Co.

FIG. 43—ARMORY AT ILION—FIRST REMINGTON FACTORY

ized for the production of Kendall's underhammer guns at about half the price of the regulation army musket, the first large order, for several hundred of these new arms, came from the Texans. The old account books show that payments for these consignments of rifles were made in Texas land, no less than nineteen hundred and twenty acres being deeded to the Hydraulic Co. in 1836. As to the Kendall rifles, they were reported to have given excellent service and long remained a favorite type among the Texans. There was even a tradition, current years ago in Windsor, that David Crockett was armed with one of these rifles when the coon said, "Don't shoot, Mr. Crockett, I'll come down!"

The reference to the Texans' method of paying for

the guns brings to mind another great difficulty of widespread trade in those early days—that of exchange. Because of the slowness and uncertainty of communication, the undeveloped condition of the banking system of the country and the general lack of ready money, the question of the transfer of funds was a very puzzling one, especially where the parties to the dealings were far apart. Long accounts were run and finally there would be some transaction in the other direction or an exchange of notes which would go to balance the account. Barter and exchange were the prevailing methods of doing business and in spite of the large cash totals appearing upon the books, it was seldom that large amounts of cash actually changed hands. The dealers in the cities often exchanged such things as tools and raw material for pumps and guns, while the local trade frequently "swapped" such homely items as salt pork, turkeys, grain, homespun cloth, mittens, potatoes, maple sugar and even barrels of cider for the manufactured products. Aside from insuring the members of the company "three square meals" and the "cup that cheers," a connection was maintained with the general store in Windsor by which the surplus of such produce was eventually turned into cash.

The travelers for the Hydraulic Co. had no very "soft job," at least as compared to the salesmen of modern machine companies. Their journeys were almost as protracted as the voyages of the old whalers and, after leaving Windsor for some such point as Apalachicola, Fla., they would be separated from the home office for months. Their trips were made (in order of luxury) on steamboats, schooners, canal boats, stage coaches, Conestoga wagons, horseback and on foot and they often suffered all the hardships endured by the pioneers of those early times—hunger, thirst, fatigue and danger.

Calvin B. Cross, the last surviving traveler of the Hydraulic Co., who died not many years ago at Windsor at the age of nearly a hundred, used to tell of a time when his funds gave out in a small town in western Missouri, while on a selling trip and in order to raise money enough to continue his journey, he tended bar in a tavern for some time. It would have taken many weeks for a letter to have reached the home office at Windsor and, as the facilities for the safe transmission of funds were very meager, he would have had to have waited a long time for their receipt, if they ever reached him, so he adopted the only sensible course by which to earn the necessary money.

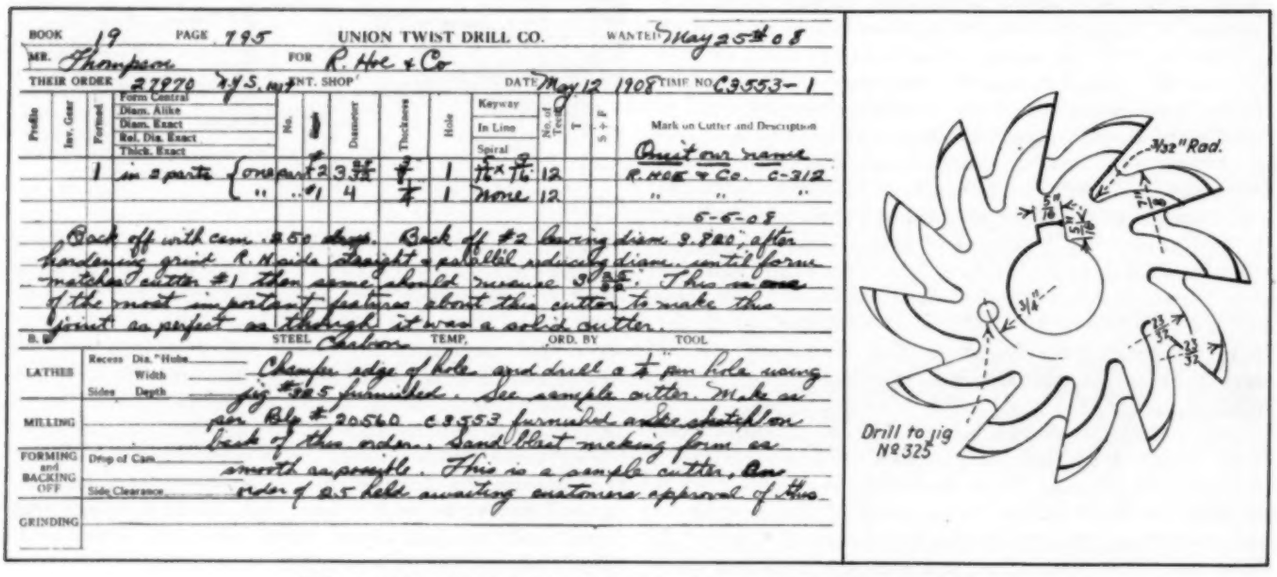
Nothing New Under the Sun

BY JOHN WRIGHT

Every once in a while something crops up to prove the truth of the old adage, "there is nothing new under the sun." It seems to me that wherever possible, when something turns up as "new," which was in use in fact or in principle years ago, the readers of your magazine should be fully informed, although I realize the difficulties in the way of an editor's knowing all the devices brought out for the past fifty years or so. I understand, too, that the *American Machinist*, by giving the news of developments in machines and tools, does not necessarily endorse them, and for that reason I can condone the omission, in the Shop Equipment News section, of references to tools of days gone by which were the same as, or similar to, something being described as just placed on the market.

To illustrate my point I refer to a type of cutter that was mentioned in your Shop Equipment News section not so long ago. The teeth of this cutter had the shape of a cantilever beam of uniform strength. No reference was made to previous existence of cutters with teeth of this shape, although as a matter of fact as far back as 1908 similar cutters were made by the Union Twist Drill Co., as shown by the accompanying reproduction of blueprint, Fig. 2, and shop order, Fig. 1, dated May 25, 1908. The cutters were made for R. Hoe & Co. I have no doubt that a search through the machine and tool shops of the country would reveal many such cutters far older than this one.

I have been much interested in the many historical articles appearing in the *American Machinist* from time to time, and hope that you will publish this short article as a contribution to any historical references to cutters that may be made or that have appeared.


BOOK 19 PAGE 795 UNION TWIST DRILL CO. WANTED May 25th 08
MR. Thompson FOR R. Hoe & Co
THEIR ORDER 27970 27S. INT. SHOP DATE May 12 1908 TIME NO. C3553-1

Profile	Inv. Gear	Formed	Form Control / Diam. Alike / Diam. Exact / Rel. Dia. Exact / Thick. Exact	No.	Diameter	Thickness	Hole	Keyway / In Line / Spiral	No. of Teeth	Mark on Cutter and Description
		1	in 2 parts	one part 2	3 25/32	7/16	1	11/16 × 7/16	12	Duit or name R. HOE & Co. C-312
			" "	#1	4	7/16	1	none	12	" " " 5-5-08

Back off with cam #50 dwgs. Back off #2 leaving diam. 3.820" after hardening grind R. Hoe's straight + parallel reducing diam. until forms matches cutter #1 then same should measure 3 25/32". This is one of the most important features about this cutter to make the joint as perfect as though it was a solid cutter.

B. STEEL Carbon TEMP. ORD. BY TOOL

LATHES — Recess Dia. "Hube" / Width / Sides Depth: Chamfer edge of hole and drill a 1/4" pin hole using jig #325 furnished. See sample cutter. Make as per Blp # 20560 C3553 furnished and see sketch on back of this order. Sand blast making form as smooth as possible. This is a simple cutter. Am order of 25 held awaiting customers approval of this

MILLING

FORMING and BACKING OFF — Drop of Cam / Side Clearance

GRINDING

FIG. 1—SHOP ORDER FOR CUTTER. FIG. 2—SHAPE OF CUTTER

It Pays to Replace—

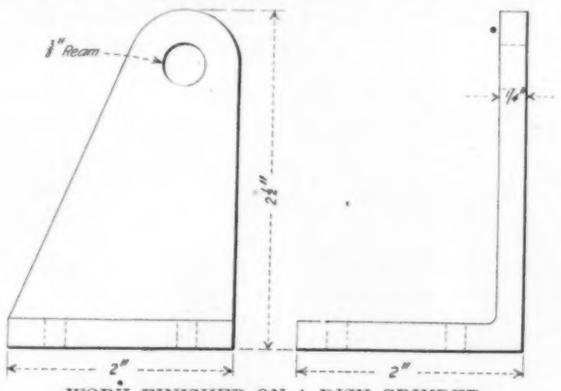
How a Shop Saved by Replacing Old Shop Equipment with New Equipment

These articles won honorable mention

By Everett L. Rudebock
Westinghouse Lamp Co., Bloomfield, N. J.

IN AN experimental department where much of the work is necessarily done by hand, and where usually only one piece or machine of a kind is made, costs often are ignored or lost sight of in order to get results. Especially does this apply to most of the men in the shop, whose chief aim, quite rightly, is to do a good job, and "make it work."

When it was decided to install a No. 1 Gardner disk grinder in our experimental department, after a number of workmen and others had expressed a wish for something of this kind, there was still some opposition and



WORK FINISHED ON A DISK GRINDER

head shaking, principally among those who knew only the old lap wheel, with its glued-on cloth disk. But when the new machine was set up, with its quarter-inch thick "G.I.A." disks, there was a general revision of opinion among the conservatives.

Many a job can now be done quickly and accurately that was formerly done much less effectively by such means as shaper, milling machine, lathe, filing machine, the side of any convenient grinding wheel, or the old reliable hand file. For instance, it is very much cheaper to face off the foot of a small bracket by holding it for a few seconds on the disk, than by setting it up in a milling machine or shaper and trying to "skin off the scale." Many small parts, whose finished surfaces are finished only for securing bearing on other finished parts, are now being disk ground instead of being faced in other machines.

One example of a kind of work frequently encountered in this department is shown in the sketch herewith. This part will eventually be a casting, but for a tryout the piece shown had to be made from angle iron. One way of doing it would be to "hog" it out of solid stock. Another would be to forge it from flat stock, and finish it in the shaper or surface grinding machine. What was done was to lay out the part on a piece of angle iron, spend a few strenuous minutes with a hacksaw, and then disk grind it all over in a few minutes more. Even if the part had been made from angle iron and finished by file and abrasive cloth, it would have taken at least three times as long to make as it took with the aid of the disk grinder, and if the mechanic had been as "fussy" as some, the job would have taken half a day instead of half an hour.

In addition to the saving of time, another important saving is effected because the machine is motor driven. This saving is in floor space, for the machine is set in a convenient but otherwise practically useless space, and no provision had to be made for putting it in reach of a line shaft.

Our disk grinder has had no medals pinned on it. The savings don't show, at least not where "he who runs may read." But they are there, nevertheless. More work is being done for a given appropriation, and faster and more accurate service is being secured in the building of experimental equipment. It is well known what a disk grinder can do on production, and this little instance is intended to give an idea what it can do on "one at a time" work. Our disk grinder has come to stay.

By Axel Halvorsen
Master Mechanic, McCormick Bros. Co., Albany, Ind.

HAVING contracted for quantities of an article which required one ring, as shown in sketch and three pieces of the smaller formation per article, and not having any special wire-forming machines in our equipment, ordinary punch presses had to be utilized. Therefore, dies were made to get production started. Afterwards we proceeded to look about for better equipment and the choice was a No. 3-24 Baird 4-slide wire-forming machine.

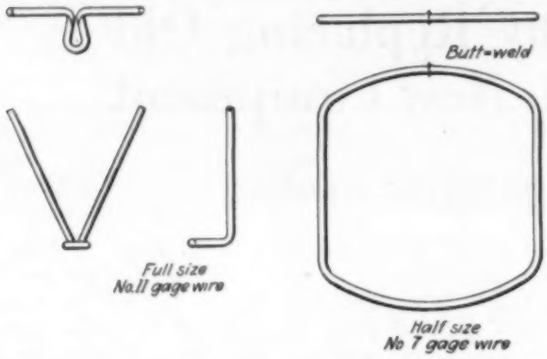
Production on the punch press required three operations for the small piece, first the wire was cut to length and followed by two forming operations and for all three operations was at the rate of approximately 5,000 or 6,000 per day. Production on the four-slide machine fitted with the proper dies and taking the wire from the coil, straightening, cutting off and forming complete, amounts to 15,000 or 16,000 pieces per day.

The large ring-shaped piece was produced on the punch press from two pieces of wire cut to proper length. Two pieces were necessary to take care of the spring of the wire and this necessitated two butt welds. The production for the press operation was about 4,000 per day. On the four-slide machine, the wire is taken from the coil, straightened, cut off and formed complete

In the contest, which closed July 5, nine prizes were given for articles telling how a shop saved by replacing old shop equipment with new equipment. The accompanying articles conclude the series.

in one operation and the production is increased to approximately 8,000 pieces per day. Moreover there is only one butt weld to make.

The difference in the production figures on the two



WORK ON WHICH PRODUCTION WAS INCREASED BY AN IMPROVED MACHINE

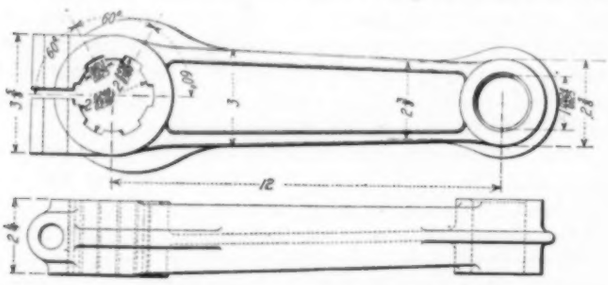
pieces of this article, made on the same machine, is accounted for by the difference in length of the wire in the formation. The smaller piece is cut 5¼ in. while the larger is cut 24⅜ in. For the larger piece a coil of wire is required every hour and the machine must be stopped for replacement, while for the smaller piece two coils would not be used in a day.

The operator of the machine takes care of another machine of the same kind and build, but of a smaller size.

The figures for production stated above show that, by getting the proper equipment, production was more than doubled and a better article produced, and prove "it paid to replace."

By Thomas E. Warburton
General Foreman, Fitzgibbon & Crisp, Trenton, N. J.

IN THE course of our work we make quantities of crank arms having six keyways, ⅜ in. wide, ½ in. deep and 2¼ in. long, as shown in the accompanying drawing. We had been cutting these keyways on a well-known keyseating machine, equipped with a special indexing fixture but had trouble in getting the keyways parallel, owing to spring in the tool and guide bars. We also had considerable trouble through the breakage



A SUCCESSFUL JOB OF BROACHING

of the tools which were of special design and difficult to make, especially for a small shop that did not employ expert toolmakers.

We were at our wit's end as to how to get greater production and more accurate work, when the foreman of the department persuaded the boss to purchase a broaching machine from the Lapointe Machine Tool Co., Hudson, Mass. The boss was skeptical as to the glowing accounts the foreman had given him regarding the work that could be done upon this machine, but awaited results.

The machine, equipped with the necessary tools for our work, was installed. The men closely connected with the job were not optimistic and were looking for something to happen when we started the machine.

We put the first job in, and the signal was given to "Let her go," and she pulled the broach through in two minutes. All the keyways were parallel and within the limits as to size. The finish was excellent.

The story is not finished. On this job there were operations of boring and reaming. The material is cast steel, fairly tough, and we had trouble in keeping our reamers up to size. Now we bore the holes to within $\frac{1}{64}$ in. of size, put a cylindrical broach through them and forget the reamers. We have broached hundreds of these parts and never had the slightest trouble, every hole being to size and having a fine finish.

We have found many other uses for the broaching machine, one of which is broaching bushings after they have been pressed into place.

While the purchase of the broaching machine was a big outlay for a small shop, the end justified the means, and the moral is: It pays to equip with modern tools.

Good Service from Countershaft Clutches

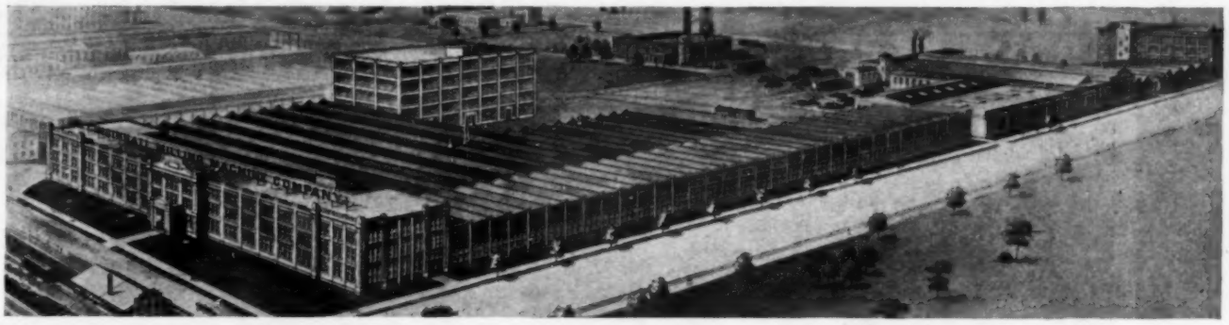
By A. W. Forbes

Two articles have appeared recently in the *American Machinist* about countershaft clutches. One (page 58, Vol. 59) mentioned the importance of oiling the clutches regularly at least once a week, and the writer of the second (page 413, Vol. 59) could not make clutches work satisfactorily anyway. Not having had any trouble with our clutches since they were new, I had almost forgotten that there was any such thing in the shop. So I took the copy of the *American Machinist* out into the shop to check up the advice.

First I came to a boy using a turret lathe, and in reply to my question he said that the clutches on his countershaft were oiled about three months before. A toolmaker on another lathe said that he had oiled his about a month before. I showed him the article in the *American Machinist* which said they should be oiled every week, and he showed me the moist oil on each side of the clutches, indicating that it was still working out, and that further lubrication was not immediately necessary.

The fact that one of these machines has been in use ten years, the other having been bought second-hand six years ago, and that the bearings appear to be in good condition without any play that can be felt by hand, although they have not been taken apart or adjusted since they were installed, would indicate that the attention they are getting of an oiling every two or three months is sufficient.

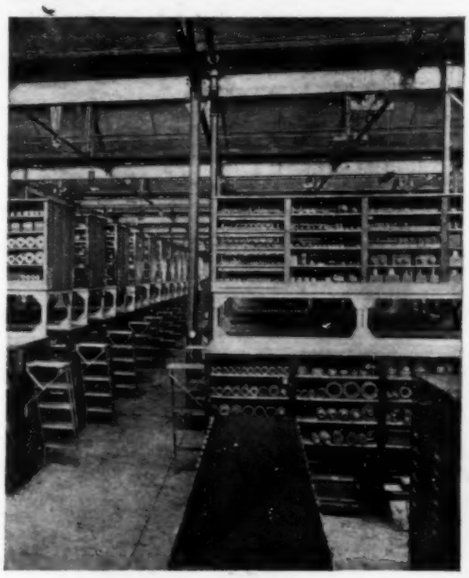
In none of our machines do the clutches limit the output. It is always the belts. I do not know who made the clutches, but they were furnished by four different manufacturers of machine tools, they are of three different styles, and all give good service. The only attention they need is the occasional oiling mentioned, and the adjustment of the friction every year or two. Some of us find these clutches more satisfactory than the writers mentioned above.



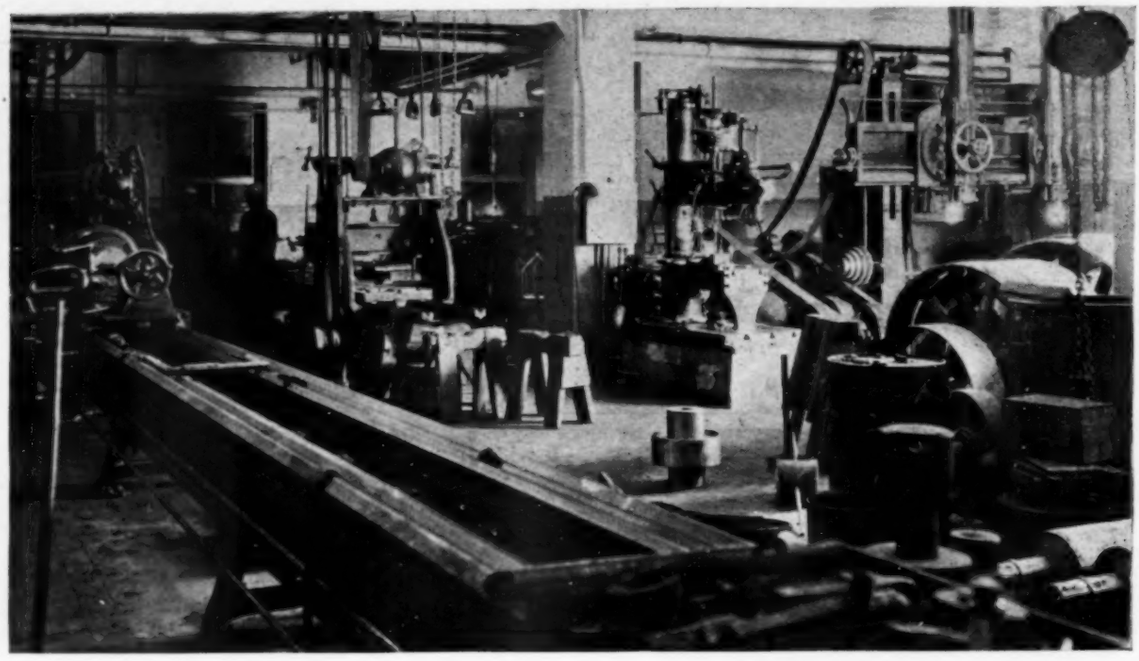
Where Machine Tools Are Made

The Cincinnati Milling Machine Company

Founded 1884

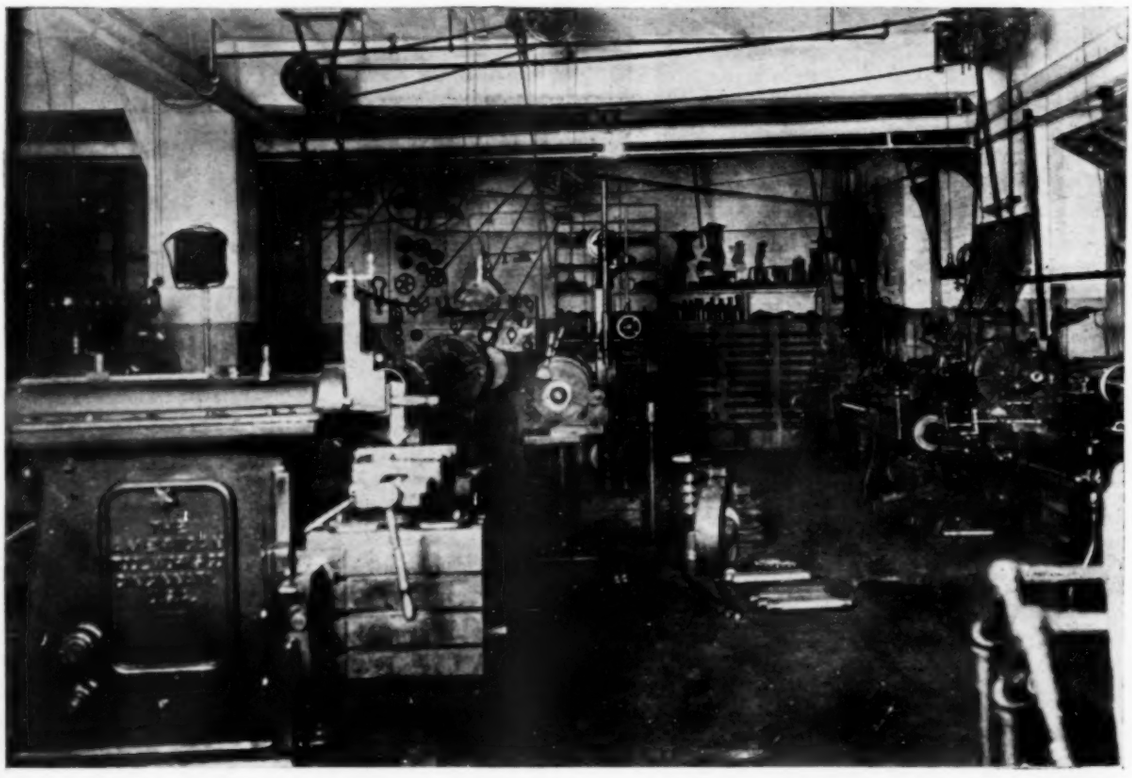


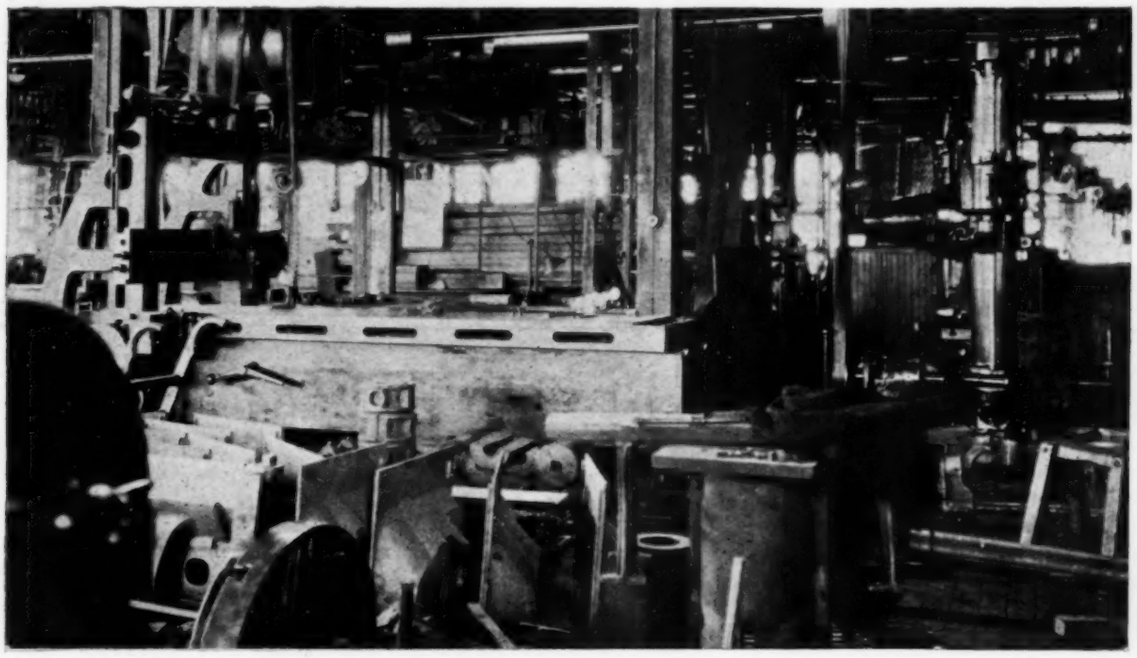
Central Tool Cribs (Above) *High Bay for Heavy Work (Below)* *Chemical Laboratory (Above)*



MACHINE TOOLS AND

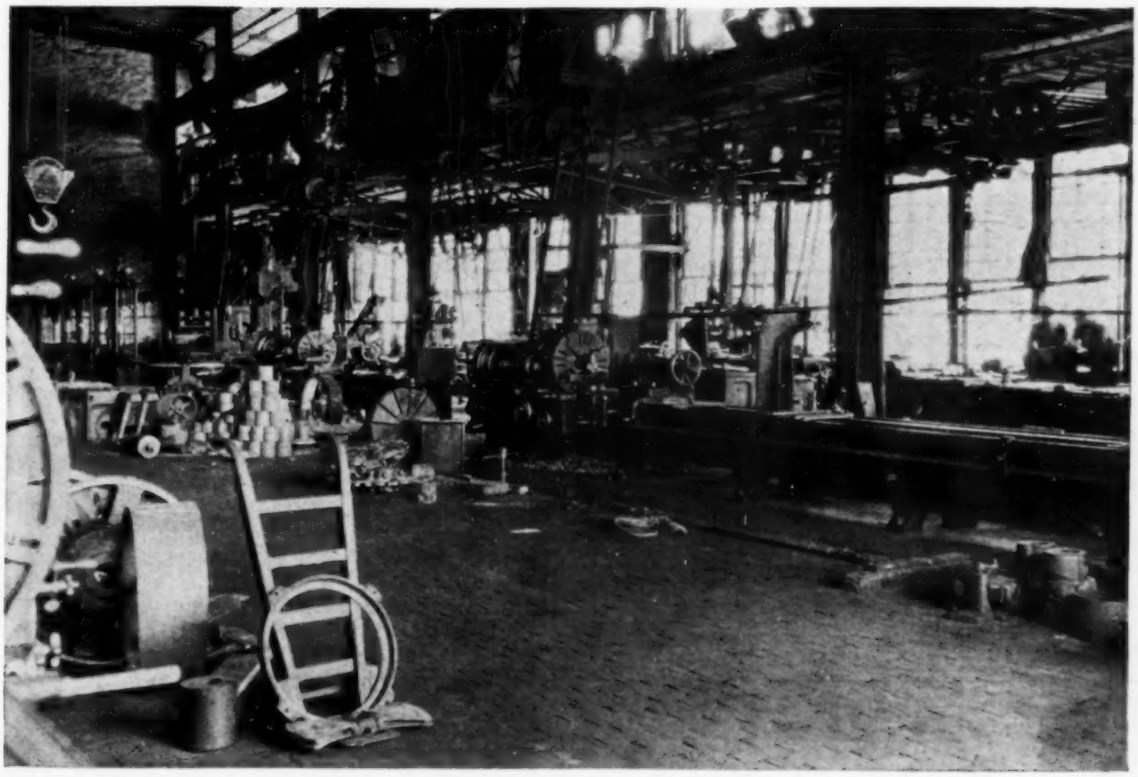
Washburn - Crosby Co.

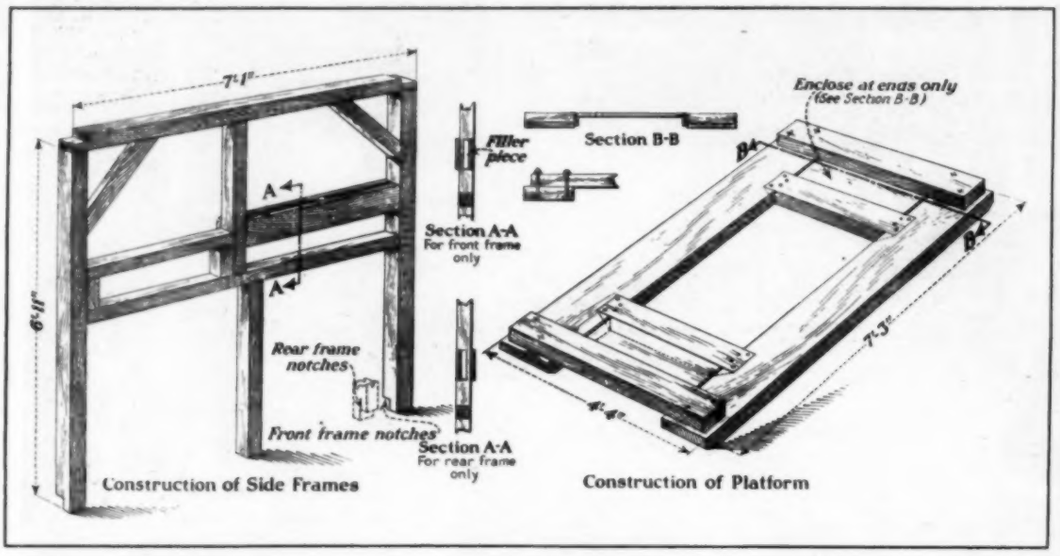




THE BREAD LINE

Pillsbury Flour Mills Co.



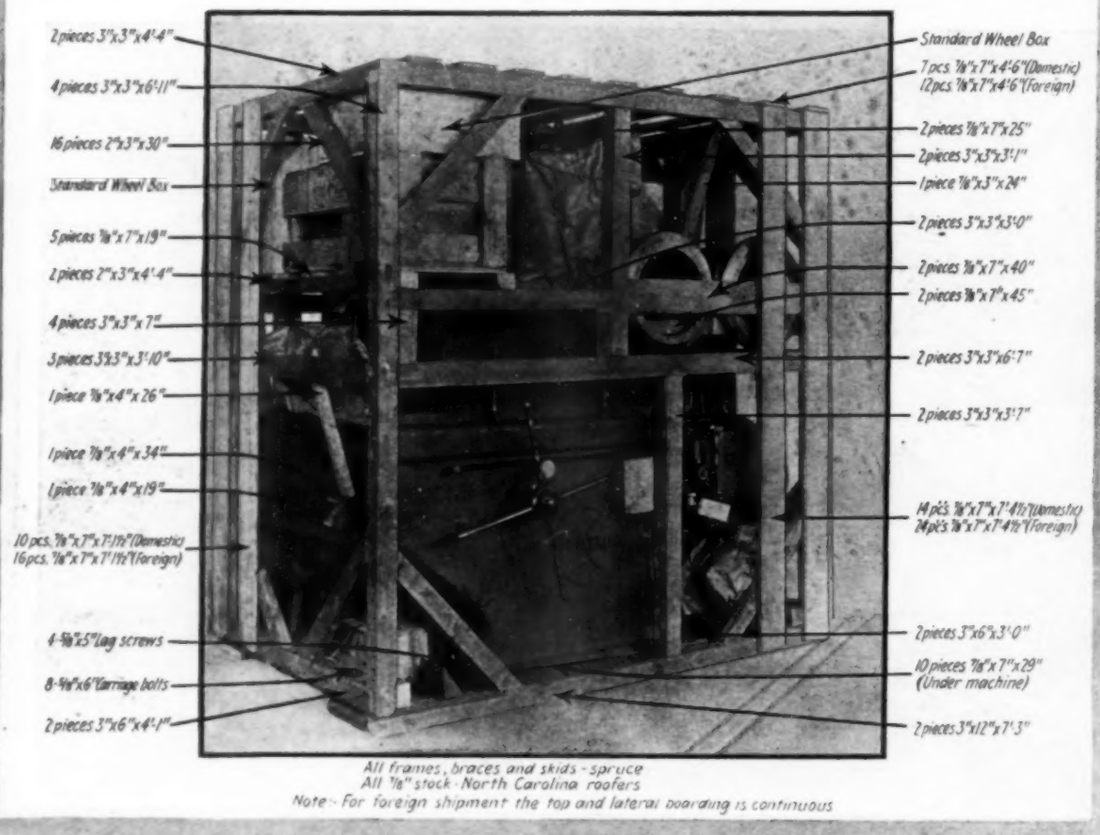


PACKING FOR SHIPMENT

THE BLANCHARD MACHINE COMPANY

Cambridge, Mass.

Crate for the No 16 Vertical Surface Grinder



All frames, braces and skids - spruce
All 7/8" stock - North Carolina roofers
Note:- For foreign shipment the top and lateral boarding is continuous

Measuring Tooth Thickness of Involute Gears

By ERNEST WILDHABER

A new method which is not affected by errors in outside diameter—Ordinary vernier caliper used — Formula for standard measurement

THE tooth thickness of spur gears is measured in various ways. The most convenient methods, however, depend on the accuracy of the outside diameter of the gear blank, and errors in the outside diameter will usually spoil the measurement of the tooth thickness.

The following is a new method of measuring the tooth thickness of involute spur gears, which does not depend on the outside diameter, and is not affected by its errors. A gear tooth caliper must be set to the proper addendum, before the chordal tooth thickness can be measured, but no such setting is required by this method. All that is necessary is to measure a straight distance, which can be done with an ordinary vernier.

In the figure one-half of an eighteen-tooth gear is shown and a pressure angle of 20 deg. has been assumed. It is evident from the figure, that the distance *AB* between the outside profiles of adjacent teeth can be a measure for the tooth thickness. If the teeth of the gear are too thin, then the distance *AB* will be smaller than it should be. If, on the other hand, the teeth are too thick, then distance *AB* will turn out too large. Moreover, the straight distance between outside profiles of involute teeth is exactly the same in any direction normal to the tooth profiles. Thus, distance *DE* is the same as distance *AB* on involute teeth, and the distance taken in any other direction, within reasonable limits, would be the same as distance *AB*, provided neither point drops below the base circle. The distance between outside profiles is, therefore, a very convenient measure for the tooth thickness.

The lines *AB* and *DE* are tangent to the base circle *b*, and their length is equal to the length of the arc of the base circle between the points where the two involute outside profiles rise from the base circle. The distances *AB* and *DE* are therefore equal to the tooth thickness in the base circle, plus one circular pitch of the base circle, when referring to the case illustrated in the figure. The way of figuring distance *AB* will be worked out later on.

Distance *AB* depends primarily on the tooth number of the gear and on its pressure angle. It also depends on the number of tooth spaces left in between the measured outside profiles. In the figure the distance between the outside profiles of adjacent teeth is measured, and consequently there is only one tooth space left in between, but in gears of large tooth numbers it is frequently desirable to measure the distance between greater numbers of teeth, that is, to leave two or more spaces between the measured profiles.

In the illustrated case of 18 teeth and 20-deg. pressure angle, the points *A* and *B* are situated below the pitch circle, which is indicated by a broken line. The points *F* and *G*, however, which correspond to two spaces left between the measured outside profiles, are

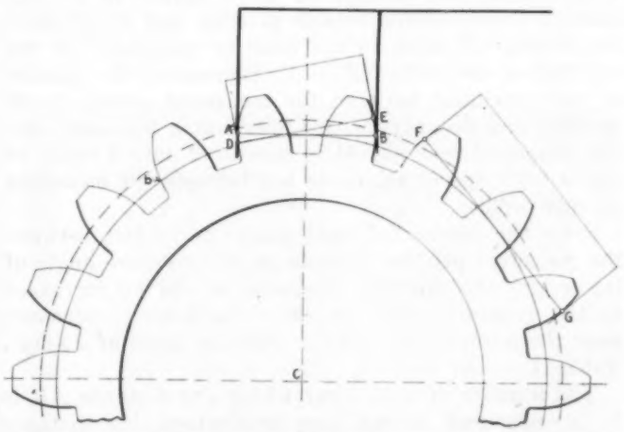


DIAGRAM SHOWING VERNIER CALIPER MEASUREMENT FOR AN 18-TOOTH, 20-DEG. PINION

situated above the pitch circle. As the tooth number increases, the distance between the pitch and base circle increases, so that *A* and *B* will drop further below the pitch circle, while *F* and *G* approach it.

It is desirable to have the measuring points close to the pitch circle, since the pitch circle area is the most important part of the tooth profile. Furthermore, it is the area which is usually free from modification of the tooth profile. The true involute shows up around the pitch circle, while frequently the tips and the roots of the teeth are somewhat modified. It is preferable, therefore, to leave between the measured tooth profiles just that number of tooth spaces which will place the contact points, between the measuring instrument and the teeth, closest to the pitch circle.

It will be assumed in the following that the tooth thickness in the pitch circle is one-half of the circular pitch, that is, that the gears are to run without play or backlash. In order to provide a slight play in the gears, the actual distance of the outside profiles should be slightly smaller than given by the figures. Under this supposition it will be found, that in the case of the usual 14½ deg. pressure angle the measuring points

A and B are very slightly above the pitch circle in an 18-tooth gear, and very slightly below the pitch circle in a 19-tooth gear. This refers to one tooth space left between the measured outside profiles.

If two tooth spaces are left between the measured outside profiles, and the measure is taken over three teeth, the symmetrical measuring points A and B are situated practically on the pitch circle in a 31-tooth gear. If three tooth spaces are left between the measured outside profiles, the measuring points A and B are slightly outside the pitch circle in a 43-tooth gear, and slightly inside the pitch circle in a 44-tooth gear. When four tooth spaces are included between the measured profiles, A and B are almost on the pitch circle in a 55-tooth gear, and the coresponding tooth numbers for 5, 6, 7 and 8 spaces are 68, 80, 93 and 105, respectively.

All this refers to a pressure angle of 14½ deg., and to a tooth thickness which is one-half of the circular pitch in the pitch circle. Such standard gears should therefore be measured as indicated by Table I, where

TABLE I—MEASUREMENT SPACING, 14½-DEG. PRESSURE ANGLE

N	12–25	26–37	38–50	51–62	63–75	76–87	88–100
S	1	2	3	4	5	6	7
$S+1$	2	3	4	5	6	7	8

S represents the number of tooth spaces to be left between the measured outside profiles, and N indicates the number of teeth in the gear in question. In the last line of the table, $(S + 1)$ represents the number of teeth included between the measured outside tooth profiles. As an example, we find that a 56-tooth, 14½-deg. standard gear should be measured over 5 teeth, or that 4 tooth spaces should be left between the measured outside profiles.

Since the number of tooth spaces to be left between the measured profiles depends on the pressure angle of the gears, the number of spaces should be increased as the pressure angle increases, in order to measure near the pitch circle. For a pressure angle of 20-deg., Table II should be used.

The number of teeth over which the distance AB is to be measured having been determined, the distance can be measured with an ordinary vernier caliper held normal to the tooth contour. This distance can then be compared with the calculated distance AB, and the tooth thickness over the measured distance determined.

A formula for distance AB which is simple in application may be written as follows, keeping in mind that distance AB is equal to the tooth thickness on the base circle plus S times the circular pitch of the base circle:

$$AB = \frac{\cos a}{P}\left[(2S+1)\frac{\pi}{2} + N(\tan a - \text{arc } a)\right]$$

in which

S = Number of tooth spaces between measured profiles
N = Number of teeth in the gear
a = Pressure angle of the gear
P = Diametral pitch of the gear

For convenience and simplicity of application the following constants may be introduced for the trigonometrical terms:

$$C' = \cos a \times \frac{\pi}{2}$$

$$C'' = \cos a\ (\tan a - \text{arc } a)$$

We can then write the equation in a simple and usable form:

$$AB = \frac{(2S+1)C' + NC''}{P}$$

The numerical values of the constants C′ and C″ corresponding to different values of a are:

a	C'	C''
14½ deg.	1.52076	0.00537
20 deg.	1.47606	0.01400

As an example in the use of the formula, let us consider a 4-pitch, 55-tooth gear with a pressure angle of 14½ deg. From Table I we find that the value of S for this gear is 4, and the numerical values of the two terms of the formula will be as follows:

$$(2S+1)C' = 9 \times 1.52076 = 13.68684$$
$$NC'' = 55 \times 0.00537 = 0.29535$$
$$AB = \frac{13.68684 + 0.29535}{4} = 3.4955 \text{ in.}$$

This is the calculated distance over five teeth on the above gear without play or backlash, or in other words, a gear which measured as above over 5 teeth would run without backlash with a gear of the same tooth thickness. If the distance AB, when measured on the gear with a vernier caliper, is found to be less or greater than calculated, the difference between the calculated and measured distances will equal the difference between a standard tooth thickness of one-half the circular pitch and the tooth thickness of the measured gear. If the measured distance is greater, interference will be found; if smaller, backlash is indicated.

Another example may serve to further illustrate the method. Let us take, in this case, a 6-pitch, 25-tooth gear with a pressure angle of 20 deg. From Table II

TABLE I—MEASUREMENT SPACING, 14½-DEG. PRESSURE ANGLE

N	12–18	19–27	28–36	37–45	46–54	55–63	64–72
S	1	2	3	4	5	6	7
$S+1$	2	3	4	5	6	7	8

we find that the value of S is 2 and that the distance AB should be measured over three teeth. Using values of the constants for a 20-deg. pressure angle, we find the numerical values of the terms to be as follows:

$$(2S+1)C' = 5 \times 1.47606 = 7.3803$$
$$NC'' = 25 \times 0.01400 = 0.3500$$
$$AB = \frac{7.3803 + 0.3500}{6} = 1.2884 \text{ in.}$$

This value of AB compared with the distance measured over three teeth will indicate the thickness of teeth on the measured gear.

Automobile and Truck Preference in Ontario

It is estimated at the present time that 40 per cent of the automobiles in use in Ontario, Canada, are closed models, which are rapidly gaining in popularity, states a report from the Department of Commerce. In some instances dealers report that 70 per cent of their sales during the past year were closed models, and all believe that the principal market in the future will be for this type—practically no European cars are sold. As in the other provinces of Canada, price, service facilities, and gasoline consumption are determining factors in automobile sales. The nationality does not influence prospective purchasers of either truck or passenger cars. About 75 per cent of the trucks in use are light trucks up to and including one ton. Another 15 per cent are delivery wagons and the balance are heavier trucks of various types.

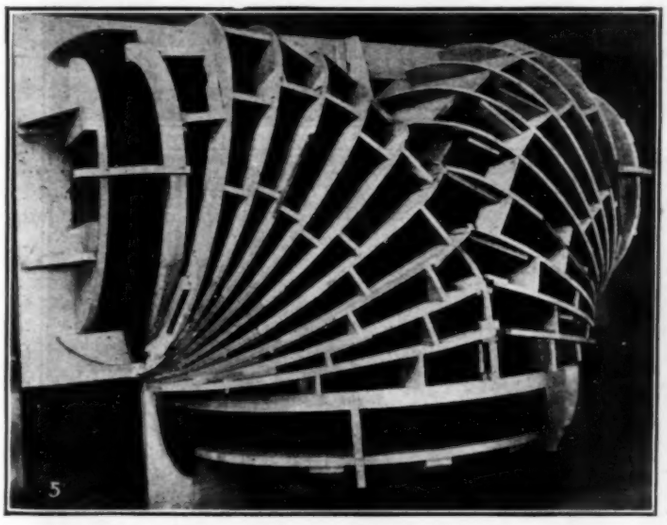
Large Pattern and Core Work on the Pacific Coast

SPECIAL CORRESPONDENCE

A method of building both patterns and cores with sand over skeleton wooden frames, to cheapen the cost, where but few castings are required

THE MAKING of large pipe connections for heavy-duty water power turbines involves many problems in pattern work, especially where costs have to be kept down, owing to the fact that but one or two castings may be required. The method used in making large pipe connections for the turbine work of the Pelton Water Wheel Company, San Francisco, Calif., gives a good example of this, as shown in the accompanying illustrations.

Instead of building up elaborate patterns and core boxes, only skeletons are made, different views of the pattern being shown in Figs. 1 to 4. Fig. 1 shows the front of the pattern in which the core prints are a continuous surface, while the pattern itself consists of numerous ribs with filling pieces fastened in between. Fig. 1 also shows the loose pieces *A*, *B*, *C* and *D* which fit on the outside of the pattern so as to form projections or bosses on the castings. Fig. 2 shows the back side of this pattern, and the arrangement of the ribs and the bracing. Pieces *A* and *B* are also



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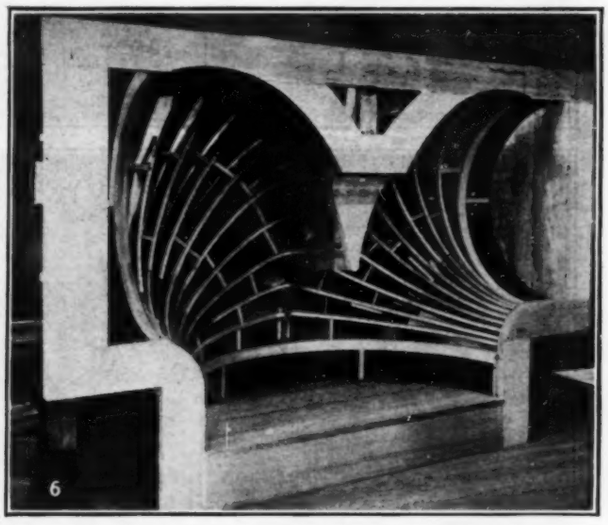

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FIG. 5
FRONT OF SKELETON FOR CORE

FIG. 6
BACK SIDE OF THE SAME SKELETON CORE FRAME

FIG. 7
CORE FRAME IN PLACE FOR BUILDING UP WITH SAND

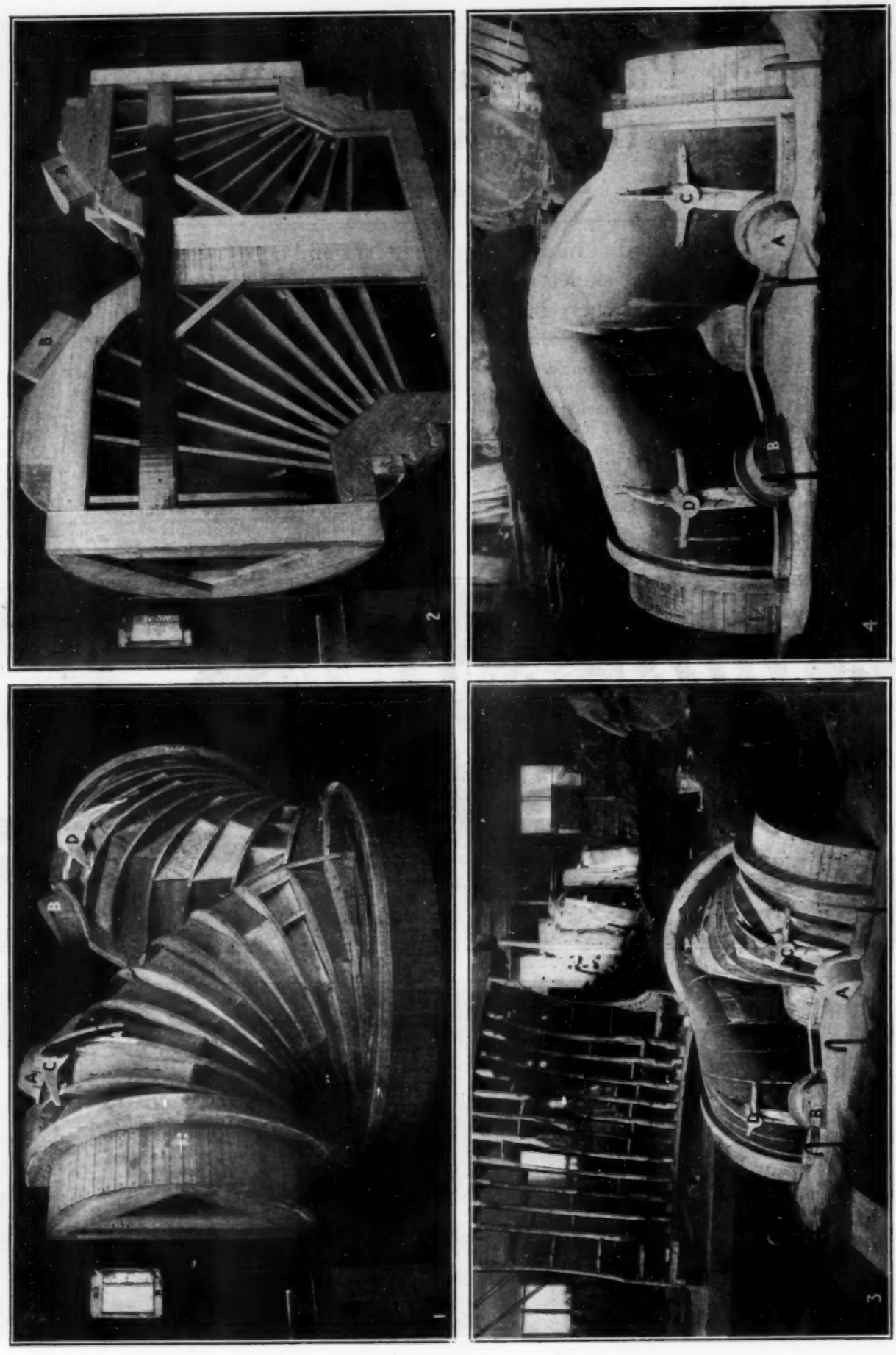


FIG. 1—FRONT OF SKELETON PATTERN. FIG. 2—BACK OF SAME PATTERN SHOWING RIBS AND BRACINGS. FIG. 3—PATTERN BEING BUILT UP, AND FLASK FOR THE MOLD. FIG. 4—PATTERN COMPLETED WITH SAND AND LOOSE PIECES IN PLACE

in place. An idea of its size can be had from the location of the wall switch at the left and the doorway at the right.

The method of using this kind of a pattern is shown in Fig. 3. Here the loose pieces *A*, *B*, *C* and *D* are in place and the left half of the pattern built up with molding sand. In the background, at the left, is the large flask which is lowered over the pattern and the sand filled in and rammed through the openings between the ribs.

In Fig. 4 the skeleton pattern has been completely covered with sand and is ready to have the flask lowered into place for filling and ramming. The loose pieces *A*, *B*, *C* and *D* are here shown in position.

The core is built up in a similar manner, the skeleton or frame being shown in Figs. 5 and 6. The core skeleton does not differ materially in general appearance from the skeleton pattern, although a few changes are noticeable. It will be seen that the boarding between the ribs is not complete, so that the whole interior of the core is composed of sand to withstand the weight of the metal as it is being poured, and while it is cooling. In the case of the pattern, only the pressure of ramming has to be taken care of by the skeleton. It will further be noted that the core prints are not boarded over at all in Fig. 5, the entire core print being composed of sand and the form secured by sweeping to conform to the two semi-circular boards on each end. When both halves of the core have been completed they are placed in position in the two halves of the mold, which have previously been made over the pattern shown in the earlier illustration.

The great variety of sizes and shapes of these fittings, together with the small quantity usually required at any one time, has made this method particularly successful in cheapening the cost.

Determining the Cutting Horsepower of a Machine Tool

By Herbert K. Keever

PERHAPS there is no more important point to be borne in mind by anyone wishing to know how to make a machine tool do its best work, than how much the machine will pull under cut. The exact statement of cutting speeds is impractical on account of the rapid progress that is being made in the art of making high-speed steels. It is practical to know, however, that with a certain type of machine a certain definite production capacity may be expected.

For purposes of analysis, let us confine ourselves to a single type of machine, for with slight modifications the following method may be applied to any type of machine tool. It may be well to state that the formulas derived are at best approximate and should serve only as a guide to the maximum theoretical cutting capacity of the machine tool. For illustration, the following formulas are figured for a geared-head, constant-speed-drive lathe. The power input will then be constant, depending upon the driving mechanism.

Assuming the radius r of the driving pulley to be 7 in., the width of the double driving belt as 4 in., a pull of 50 lb. per inch of width of belt, and a constant speed of 650 r.p.m., the constant horsepower input will be

$$Hp. = \frac{2\Pi rPN}{12 \times 33{,}000} = \frac{2 \times \Pi \times 7 \times 200 \times 650}{12 \times 33{,}000} = 14.4 \text{ hp.},$$

where P = Width of belt $\times$ pull per inch of width, and
N = R.p.m. of driving pulley.

The horsepower delivered at the spindle end of the machine to the piece of work is usually somewhat less than this, some engineers figuring a one per cent power loss for each bearing. Usually the power loss in a geared-head machine is somewhat more than this amount, and can be determined accurately by experimentation only. The manufacturers of machine tools usually furnish the effective driving power of their machines, upon request. Assuming a 50 per cent power loss in the head, the amount actually delivered at the work in this case would be 7 horsepower.

The pressure upon the cutting tool is determined by the area of cut, and a good rule to follow in this regard is

$$P = 3 \times A \times U,$$

where,

P = the pressure on the tool in pounds,
A = the area of cut, or feed $\times$ depth of cut, and
U = the ultimate tensile strength of the material.

From the horsepower formula,

$$P = 63{,}025 \frac{\text{Hp.}}{Nr}$$

Substituting $3AU$ for P and 7 for the value of the horsepower,

$$3AU = \frac{63{,}025 \times 7}{Nr} = \frac{441{,}175}{Nr}$$

$$ANr = \frac{147{,}058}{U}$$

This last formula may be called the fundamental formula for the machine, which in this case delivers 7 hp. at the spindle of the machine. In this formula the different constants may be determined from the tensile strength of the material to be machined. Marks' "Mechanical Engineers' Handbook" gives the following values for the tensile strength of different materials:

U = 18,000 lb. per sq.in. for cast iron
U = 30,000 lb. per sq.in. for malleable iron
U = 60,000 lb. per sq.in. for mild steel
U = 80,000 lb. per sq.in. for hard steel
U = 120,000 lb. per sq.in. for nickel alloy steel

Since the area of cut is the product of the feed and the depth of cut, and substituting our values for U in the fundamental machine formula, the following formula for working use is obtained:

$$D = \frac{K}{FNY},$$

where,

D = depth of cut,
F = allowable feed,
N = r.p.m. of work,
Y = diameter of work, and
K = constant for the material.

Values of the constant as determined for the 7-hp machine are

K = 1.64 for cast iron
K = 0.98 for malleable iron
K = 0.50 for mild steel
K = 0.38 for hard steel
K = 0.25 for alloy steel.

Book Reviews

Wood Pattern Making. By Herbert J. McCaslin, Instructor in pattern-making, Dickenson High School, Jersey City, New Jersey. 285 4¾x7¼-in. pages, illustrated. Published by The McGraw-Hill Book Co., 370 Seventh Ave., New York City. Price $2.25.

This book is intended to be used as an instruction or textbook in vocational schools and other places where pattern-making is taught. The experience of the author as an instructor in such schools should enable him to judge correctly as to the nature and extent of textbook training that the average student is capable of absorbing.

The opening chapters are designed to convey to the student a knowledge of the various woods used in the construction of patterns, their peculiarities and adaptabilities to specific purposes, and the methods of preparing them. A list of the machines and tools required by the pattern-maker is given in the introductory pages and the use and application of the various tools is explained in succeeding chapters as the work proceeds.

The student is started with instructions as to the necessary steps to be taken in the making of very plain and simple patterns and is carried by easy stages to the construction of those of a more complex and difficult nature. Foundry practice is taught to some extent by illustrations of the molds and descriptions of the manner of making them as applied to the specific examples given; though this feature, so essential to the finished pattern-maker, could be strengthened to advantage.

Workmen's Compensation Acts in the United States, The Medical Aspect, Research Report No. 61. Paper covers, 6x9 in., 282 pages, 21 tables. Published by the National Industrial Conference Board, 10 East 39 St., New York, N. Y.

The volume deals with the medical questions related to the action of workmen's compensation laws in the United States. The first research report, published by the Board in 1917, discussed the legal questions involved in the administration of the workmen's compensation laws. At that time the legal aspect was of primary importance, and the experience with the medical questions was so limited that no great import was attached to that phase. The medical experience is now available in the records of decisions of the courts and of industrial boards and commissions.

In order that the legal status of compensation laws may be understood, the report presents an analysis both of the provisions of the laws dealing with medical and related questions, and also of the decisions of courts upon them. Thus the principles and practices that have been developed are shown in the light of the legal provisions and of the interpretations placed upon them by commissions and courts.

No attempt is made in the report to criticise the laws or decisions. What is done is to bring together and analyze a large body of facts on the subject and make them available in convenient form, as the first comprehensive study of the subject that has been undertaken. Study of the conditions can be easily made, so that the report should bring about constructive work.

The medical side of compensation laws has greatly increased in importance in the past few years. One reason is the inclusion of diseases of occupation in the later laws, and also the granting of compensation for diseases having only a casual and sometimes remote connection with the occupation or with the original injury. The different phases are illustrated by references to a large number of actual cases, so that the precedent existing under various conditions is shown. Due to the wide scope and comprehensive treatment, the volume should serve as a handbook on the subject of workmen's compensation.

The Worker in Modern Economic Society. By Paul H. Douglas, Curtice N. Hitchcock and Willard E. Atkins. 929 pages, 6x9 inches. Published by the University of Chicago Press, Chicago, Ill.

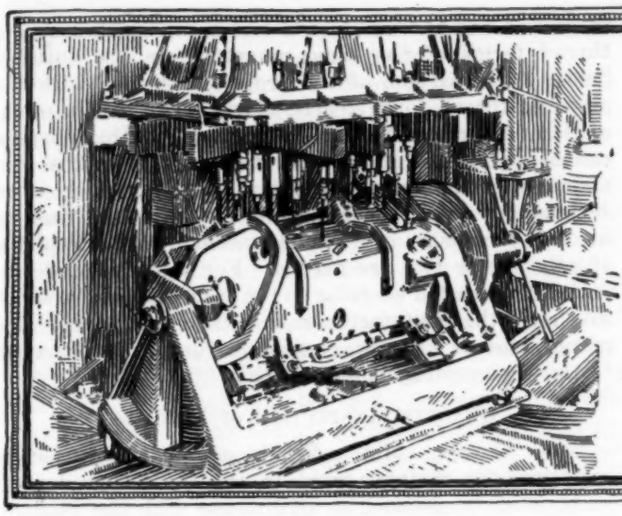
This book presents what is probably the most complete study of what we call the labor problem that has ever been gathered into a single volume. It is divided into seven distinct parts, the first dealing with human nature and industry. Then comes the development of economic organization; the worker in his relation to the market; security and risk; the workers approach to his problems; the employer's approach and, lastly, the community's approach. Each of these parts is divided into numerous chapters which deal with the various phases of the problems considered under its particular heading.

In each chapter have been gathered the opinions and studies of men and women well known in their various fields—such names as William James, John Dewey, Royal Meeker, John R. Commons, W. M. Leiserson, Crystal Eastman, Helen Marot, P. T. Sherman and others well known on both sides of the question. Statistics from many government bureaus and private organizations, both in this country and abroad, are included, so that the reader need not fear hearing only one side of the argument.

It is, of course, impossible to give an adequate idea of the contents of this volume in a review. But those who are really interested in the problems which it touches, will be interested in the manner in which this volume traces the development of economic organization, the question of wages and standards of living, the length of the working day, industrial accidents, occupational diseases, health insurance, old age pensions and unemployment.

The chapter showing the development of unionism in the United States is of particular interest and indicates very clearly that we have been unduly alarmed over the temporary growth of some of the socalled radical organizations. The open and closed shop, collective bargaining, strikes and losses occasioned by strikes and lockouts, apprenticeship and its limitation, labor's share in industrial waste, profit-sharing, minimum wages, compulsory arbitration, and apparently all the points which we too frequently discuss without full knowledge on either side, are here analyzed and presented in a valuable and readable form.

The authors are to be commended for the impartial manner in which they have handled both sides of the question without fear or favor. Those who expect to read that the particular side in which they are interested possesses all the virtues are doomed to disappointment. The book is to be highly commended to all real students of modern economic society.



Tool Engineering

By

Albert A. Dowd and Frank W. Curtis
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Gaging screw threads—Importance of accurate methods of manufacturing and gaging—Inspection by optical projection—Automatic gaging machines—Providing for upkeep in designing gages and tools

IN A PREVIOUS article we have mentioned the important points in the gaging of screw threads, and we have illustrated a number of forms of work gages used in keeping the work within the required limits of accuracy. After work of this kind has been completely machined, the final inspection of thread form, pitch diameter, angle of thread, lead and similar points is used as a check on the accuracy before the parts are sent to the stock room. The practice for final inspection of threads varies in different factories, the controlling factor being the accuracy required in the finished product.

When screws of various kinds are made in large quantities, as in the case of a factory devoted exclusively to this class of work, the greatest care is taken to see that the parts are held closely within the specified limits during the process of manufacture. The final inspection is to a great extent used to detect imperfect work which may have been caused by poor stock, flaws in the material, threads damaged after or during manufacture, and other causes. At the same time a final inspection is absolutely necessary in order to check up the accuracy of the work and to see that the quality is fully equal to the commercial requirements.

Importance of Accurate Manufacture

In every variety of mechanical work the methods and tools used in the manufacture are of the utmost importance if an accurate product is to be made. Hence, the progressive executive aims always to perfect his manufacturing methods in order to avoid inaccuracies and reduce "scrap" to a minimum. This can only be done by painstaking effort and conscientious endeavor to make sure that all tools, jigs, fixtures, and gages are well kept and the best of their kind, and also that all machine tools used in the work are in first-class working condition.

In considering the manufacturing methods used for screw threads, either external or internal, there should be such careful supervision and such thorough tests during the process as to eliminate the likelihood of errors as far as possible. Rigid inspection of taps, dies and chasers, combined with careful selection, and exacting limits in manufacturing will aid greatly in keeping down the cost of inspection and will result in a superior product.

We have previously mentioned the types of gages used for work in the actual process of manufacture. In classifying gages, an endeavor has been made to separate those used by the workman who operates a machine, from those which are used by an inspector at the bench or elsewhere. In the inspection of screw

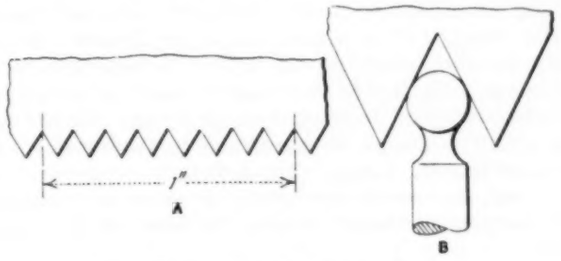

FIG. 564—TESTING LEAD OF SCREW

threads there are so many points of importance to be looked after continually, that the inspector and the workman must be in very close touch with each other. Errors in lead must be caught by the inspector before too many pieces have been made, as otherwise the scrappile would increase too rapidly. A faulty tap or imperfect chasers can cause a great deal of trouble and expense, so the safest thing to do is to inspect them before they are issued from the tool crib.

One of the most troublesome matters in connection with screw threads is the accuracy of the lead of the screw. Yet, how can it fail to be so when we consider the possibility of variations in taps, dies, chasers and lead screws of different machine tools. Also, there are the various kinds of steel used, the treatment in hardening and the changes caused by different methods or ignorance in handling. A realization of the importance of the lead of the screw has brought about a radical improvement in methods of manufacturing taps, dies and chasers, as well as in the quality of the steel used in the work. Careful experiment has also shown us how much tolerance in the lead of the thread is permissible for good commercial work.

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The United States Government has established standards and tolerances for work of this character, and many manufacturers have modified them to suit their own requirements. The government specifications are very exacting, and a great amount of commercial work does not require such close limits of manufacture. It is very evident that the nature of the work itself is a factor of great importance in determining the accuracy required, as screws used in farm machinery and other mechanisms of a more or less crude variety, do not need to be as accurately made as those for machine tools or automobiles.

If the lead of a screw or nut is incorrect to any great degree, long screws will bind or crowd in the thread when assembled with the nut or in any kind of a tapped hole. Also, the wear on the thread is not uniform and trouble results on this account, particularly when the nature of the work requires the screw to be removed and replaced frequently. In testing the lead of screws or taps several methods are in use, but in the majority of cases the lead is tested at points 1 in. apart. In the case of short threads, a measurement of ½ in. is sometimes necessary. In very long threads, such as lead screws for machine tools and other work of similar kind, greater distances are used as a basis of measurement in order to detect any accumulation of errors.

The diagram in Fig. 564 gives an idea of the method used in testing the lead of a screw. The example *A* shows a screw having 8 threads per inch according to theory, yet a practical test may show variations of several thousandths of an inch from the exact lead. By using ball points which come in contact with the thread at the pitch line, as shown at *B*, any variations can be easily detected if a suitable indicator is used. Several instruments for testing the lead of screw threads are on the market, but as they are commercial products it is unnecessary to describe them in detail. We are dealing with the design of gages and not those which are already manufactured. The principle employed, however, may be mentioned briefly in order to familiarize the designer with the general features of the instrument.

Device for Testing Lead

Roughly speaking, a lead tester consists of a holder of simple form in which two ball points are inserted. One of these points is adjustable so that it can be readily set at a fixed distance from the other, and a suitable connection is made to an indicator point by means of which variations in the lead can be readily seen when the ball points are in contact with the threads. The holder can be mounted on a stand provided with adjustable centers for holding the work to be tested, or the work can be placed against a parallel or straight edge placed in a suitable position. For special threads on castings or irregular parts of various kinds it may be found necessary to design a special stand to suit the conditions, but the designer has had sufficient training to enable him to do this without great difficulty. It is always a good idea for the progressive man to keep in touch with new developments in gaging by following the advertisements and notes of new tools in the trade papers, and to obtain detailed information wherever possible.

Probably the most satisfactory method of testing screw threads for shape of thread, angle, and lead is by means of projected shadows of the thread, greatly magnified and thrown upon a screen on which accurate thread forms of the same magnification are suitably held. A comparison of the projected shadow with the accurate thread form clearly shows variations in pitch, angle and form of thread. Machines for this purpose can be purchased of the manufacturers at prices consistent with the value of the device. It is usually more satisfactory to purchase machines of this kind than to attempt the design of a similar mechanism, particularly if only one or two are needed. For those who are especially interested we refer to the trade papers, in which are listed the manufacturers and their addresses. The manufacturers are always glad to furnish information to those requesting it and writing for catalogs.

Quantity Inspection of Threads

When screws, bolts and nuts are manufactured in quantity, the methods used in the inspection department must be devised in accordance with the requirements. Usually the inspector selects a few pieces at random from a quantity of work, tests them for pitch diameter, lead and quality of workmanship, as well as general finish and appearance. He then passes or rejects the entire lot according to the result of the tests made. If the work is very exacting, each and every part is carefully inspected by means of limit gages of standard form, and those which have not been machined within the required limits are rejected.

Designers are occasionally required to design gages of a type particularly suited to rapid inspection, but as a general thing such work requires only mechanical solutions of problems that are ordinarily solved by the use of several successive gages in the hands of a competent inspector. We believe that sufficient information has been given in these articles to enable a designer to understand thoroughly the principles of gaging, so that by a judicious application of the principles he can adapt them to suit a variety of conditions.

We do not feel that we should close the subject of gaging without mentioning some of the recent developments in automatic inspection of certain standard products, and while we are not free to illustrate these methods in detail we can give our readers a general idea which may be of interest. Naturally, the gaging of parts in an automatic manner, should be attempted only when very large quantities of the product are being manufactured. Furthermore, it is not usually possible to gage more than one dimension at a time, although a semi-automatic machine requiring the constant attendance of one inspector might permit two dimensions to be gaged simultaneously. To the best of our knowledge, however, this has not as yet been done successfully.

Some years ago steel balls such as those used in ball bearings were rapidly gaged by passing them over a hardened anvil and at the same time under an indicator point, the dial of which registered very accurately variations in the diameter of the balls. This method was naturally somewhat slow and the accuracy obtained was dependent entirely upon the inspector. Other devices were experimented with in order to eliminate the human factor as far as possible. One of them was designed so that oversize and undersize balls made an electrical contact which rang a warning bell. An attendant was required to remove the defective balls and place them in a separate box, from which they were afterward taken and graded according to their sizes. All of these methods required considerable time and were not abso-

lutely infallible, because occasionally balls would pass through that should have been rejected.

There are several designs of automatic ball gaging machines in use at the present time, and although they are somewhat different in general details of construction, the principles employed in gaging are practically the same. The balls are dumped into a hopper which is oscillated automatically in order to keep the balls moving freely. At the bottom of the hopper there is a revolving disk with one or more slots in it of sufficient size to admit one ball at a time. The ball passes through the disk and rolls down an inclined plane until it reaches an accurately graduated slot, at which point it drops through if of the correct size.

If oversize, the ball remains in the slot until a plunger (mechanically operated at the proper time) pushes it up above the slot, so that it rolls along down the inclined plane until it reaches the next slot, which is a trifle larger than the first. The same process is repeated here as at the first slot, if it is still too large to pass through, and so on according to the number of slots provided. Underneath each slot is a chute through which the balls roll to their respective boxes. The only attention needed is to keep the hopper supplied with balls and to carry away those which have been sorted. All parts of the machine subject to wear are readily replaceable, and the gage plates are detachable so that they can be quickly changed when necessary.

Automatic gaging is much more adapted to spherical or cylindrical work than to that of a rectangular shape. Taper and cylindrical pins of small size can be gaged semi-automatically by using slots and angular plates, but there are more chances for errors on this class of work than in the gaging of balls. Pins which are intended to be cylindrical may be "out of round" or otherwise mis-shapen, so that they will not pass the gage points properly.

Automatic Gaging for Taper Pins

Tapered pins, however, can be gaged by an application of the tapered plate principle, the pins dropping through the plate as they pass along down the incline. In designing any gages of this nature the greatest care must be taken to find out by actual experiment the correct angle of inclination for the tapered plates. Too steep an incline will allow the pins to pass by the gage points, and too gradual an angle will not permit the pins to slide freely. There are problems connected with automatic gaging which the designer must study and solve for himself, being satisfied to proceed slowly and to experiment wherever necessary in order to settle any doubtful points.

It is not often that this class of work is called for in gage design, yet when opportunity offers it is well to take advantage of any chance to see how progressive manufacturers have solved such problems, in order that new ideas may be absorbed and new principles in gaging appreciated and thoroughly understood. It is always the part of wisdom to take advantage of any ideas which have been proven successful and apply them whenever the opportunity presents itself. If certain things have been done in a satisfactory manner by using a certain principle, it is much better to work along the same lines, unless you are fairly certain that another idea will be more successful.

In closing our discussion of gages it seems necessary to point out briefly a few of the important matters in tool and gage design, which are likely to be overlooked or forgotten by the designer who is comparatively new to this kind of work. Some of these points have been mentioned in a general way in previous articles, but we believe it advisable to mention them more specifically here in order to emphasize their importance to the entire subject of tool engineering.

(1) Economical upkeep of tools and gages is dependent to a great extent upon the skill and forethought of the designer. All locating pads, V-blocks, leaf locaters, set blocks and other parts subject to wear and which vitally affect the accuracy of the work, must be made and located in such a way that they can be readily replaced when worn or broken. Dowels must be placed in all pieces which are likely to require removal or replacement in order to ensure correct location. Jigs and fixtures should be designed to stand not only use but considerable abuse, and yet they should be as light as consistent in order to facilitate handling. It is often advisable to make very large jigs and fixtures in sections in order to assist the toolmaker in machining them. There is an additional advantage to this method in the event of breakage or injury to an expensive jig. Each of these points is important and has an effect on economical upkeep.

Tools for Turret Lathes and Boring Mills

(2) Upkeep of cutting tools for turret lathes and boring mills can be very easily provided for by care in the design. Such tools as those used for turning and boring should invariably be made so that they can be quickly replaced after grinding or when broken. Tools like reamers when of large size should be made with inserted blades, located in such a way that they are locked firmly in place, and yet can quickly be removed and others inserted in their places when necessary.

Cutter heads or boring heads should also be made with inserted blades whenever possible. The method of locking the blades is dependent entirely on the construction of the heads, but this matter has been thoroughly discussed in our previous articles. Cross-slide tools should be made so that standard sizes of stock can be used whenever possible, in order to avoid the expense of machining the stock before using it. Form tools should be so designed that they can be ground on one face only without changing their form. All tool blocks should be provided with such adjusting screws or hardened studs that tools can after grinding be replaced in the exact positions from which they were originally taken.

(3) Upkeep of milling cutters is dependent to a great extent upon the size and shape of the cutters. For small diameters the inserted-tooth variety cannot always be used, and for this reason the upkeep is not so good as it otherwise would be. For slotting cutters the interlocking type which has been previously mentioned should always be used if the width of the slot to be machined is important. Formed cutters should always be made so that they can be ground on the face without changing the form.

(4) The upkeep of punches and dies is more difficult to provide for than some of the other varieties of tools. Provision should always be made for grinding the face of the die as well as the punch, and sufficient "land" should be allowed to give as great a number of regrinds as possible. In the case of dies of very irregular form and those with sharp corners, a built-up die is often more economical than a solid die, and it is much easier to make replacements in case of breakage. Other points pertaining to the upkeep of punches and dies have been

mentioned in previous articles, and it would be a good idea for the designer to review these matters carefully before starting work of this kind.

(5) The upkeep of gages requires careful study from more than one angle. It is evident that any gage is likely to be dropped on the floor and possibly distorted by the shock. Cast iron is much more rigid than steel, and while it may break it will seldom spring out of position. For this reason many manufacturers prefer to use cast iron frames for gage work, because they think it much better to have a gage broken completely than to take the chance of using one which may have been "sprung" so that it is no longer accurate. Gage points and wearing surfaces should always be made replaceable, and the construction should be such that there will be no possibility of errors in the relocation of the parts. Indicator points and any fragile mechanisms should be protected from injury by guards of suitable form and shape. An exposed indicator pointer can very easily be sprung out of shape and rendered inaccurate. Test blocks or some other provision for the accurate setting of indicator gages should always be provided, so that the accuracy can be continually checked to make sure that it is always correct. Otherwise, an inaccurate gage might be kept in use.

With the growing tendency toward the use of indicator gages it becomes more and more important to provide against inaccurate settings of these instruments, and for this reason we wish to call the designer's attention particularly to this matter. Let him consider that it is fully as important to design setting gages for the instruments as it is to design the indicators themselves. There are many manufacturers who dislike indicator gages for the reason that there is a possibility of inaccurate settings, which may cause a great deal of trouble in the finished product.

Speed Versus Good Welding

By R. G. Mason

THE average man engaged in manufacture or repair shop work actually knows very little about practical welding. He has learned considerable of the remarkable results that may be obtained from oxy-acetylene welding, from gossip and very little reading. Unconsciously he acquires the notion that all such welding must be like that he has heard of, so when an emergency arises he at once determines to have his broken machine welded, forgetting that there are good welds and welds that are not good. Broken machinery welded under his emergency directions breaks again, and it is not unusual for him after such minor experience to thereafter condemn the principle of fusion welding.

The science of gas welding is in its early infancy, and although progress has been made, the unknown fields for the application of welding are probably much greater than those already discovered. The old time method of welding iron and steel in the forge was a part of the blacksmith's trade, but today welding is a science—laws of chemistry, physics and metallurgy must be reckoned with if we are to progress. Of the other trades one stands out where science must be taken into consideration—that of the electrician, and in this case as also that of the art of welding, the workers must know why certain things happen when this or that is done.

Speed May Bring Hidden Defects

You would not consider for an instant the use of a sledge hammer to drive nails in a shingle roof, just to gain time by driving the nail with one blow of the hammer, yet very frequently just such a foolish thing is tried in the electrician's work and in welding. In a like manner the finished article may have a beautiful appearance, yet laminations, "cold shuts," impurities, oxidized metal, poor penetration and other defects which are the causes of many failures may be covered up. Sometimes these things are done in ignorance on the part of the welder or it may be wilful negligence, and sometimes these conditions are forced upon the operator by those who are having the article welded, for it is generally accepted by the customers who are having some repairs made that the only thing to be kept in mind is "get the job finished," the sooner the better.

In certain emergencies it may be cheaper in the long run to make emergency repairs in order to keep up production or to maintain service. However, only in cases of the rarest emergency should excess speed be used when the job or repair is to be made by the welding process.

Wastes Due to Excess Speed

There are, of course, several plausible reasons why a weld fails, such as, what caused the break in the first place, ignorance on the part of the welder, impure material, improper preparation or too much speed or heat. This article deals with the last named cause, and many hours of grief as well as dollars can be saved if one will accept the experience of others.

Let us assume that in the manufacture of a certain article by welding the operator is urged to hurry up, as is generally the case. Naturally it requires more heat to melt and fuse the material in a shorter space of time. The welder must put a larger nozzle on his torch, which gives a larger volume of heat, but incidentally also the blast or force is greater, another wrong condition. Too much heat causes failure, just as not enough heat will make a poor job. Too much heat is a waste of both oxygen and acetylene. It also causes the operator unnecessary discomfort and may slow up his work.

Second, excess heat will vaporize the molten metal, causing a waste of filler rods—more money thrown away.

Third, some of the elements are burned out, leaving weak oxidized metal, and failure is bound to occur.

Fourth, the molten metal will become more fluid and will splash over on a cold surface, causing adhesion instead of the proper cohesion.

Fifth, it breaks down the "Vee" in such a way that good penetration cannot be obtained.

These are only a few of the troubles resulting from trying to push a job beyond its limits and using an excess of heat to do it. The faults can be seen plainly by the customer if he will have a few test pieces made for his benefit.

It is a known fact that a better weld can be made in less time and with less filler rod with the proper amount of heat, than when we look only for speed in finishing the article. Moreover, when the correct heat and size of filler rod are used, there is no question of success.

From the *Journal of the American Welding Society*

A New Herringbone Gear Planer

BY N. LEERBERG

Features of design proposed to overcome difficulties usually encountered—Two tools cut simultaneously and move in helical path—Work held stationary during cutting to give stability

THE LAST few years have shown an enormous advance in the use of herringbone gears. Machines for cutting the finer pitches, up to 1 D.P., have been well developed, hobbing being the principal process by which such gears are cut. Other methods are end milling and shaping by rack- or pinion-shaped cutters. When pitches become greater than 1 D.P. these methods have several drawbacks. The cutting surface of the tools becomes so great that it is difficult to obtain sufficient rigidity for efficient operation. It is necessary to machine the teeth from the solid blank, requiring the removal of great quantities of metal, and also giving a metal not as close grained as when the teeth are blocked out in casting. It is for such work on coarse pitches that the planing process is best adapted.

When planing spur gears the gear is clamped rigidly, and the tool works very efficiently. Herringbone gear planers were made along the same lines, except that the gear blank was made to rotate as the tool advanced along the face of the gear. The spring in the gear blank when the latter was much over 6 ft. in diameter made it impossible to make good time on such a machine.

About seven years ago a machine was developed in which the gear blank was clamped rigidly while the tool passed along an approximate helical path, a decided improvement over earlier machines. Based upon this experience, the writer designed a machine that would have all the good points of the spur-gear planer, a rigidly clamped gear blank and a well-supported planing tool.

ACTION OF THE MACHINE

The principle of the machine is as indicated diagrammatically in Fig. 1, and the motion is the resultant of the longitudinal motion *AG*, vertical motion *AB*, transverse motion *BF*, radial motion *FC*, and angular motion a. The primary motion is therefore the development of a helix in a vertical plane tangent to the pitch cylinder. But this development is constantly being folded unto the cylindrical pitch blank as follows: The pivot point is moved transversely the distance *BF* until it falls on the proper radial line. The tool is then swung radially around a pivot following the line *AF*, and thereafter moved along the radial line until the cutting point falls at the pitch line. All these motions are simultaneous.

Mechanically these motions are produced as shown on the drawings reproduced in Fig. 2. The front elevation shows the machine to consist mainly of two sole plates *1a* and *1b* carrying the base plate *2* on which are mounted two columns *3a* and *3b*. These columns carry two vertical slides *4a* and *4b* having pivots *5a* and *5b*. The planer rail *6* is supported by these pivots as well as by the worm drives *7a* and *7b*.

The tool-head carriers *8a* and *8b* slide simultaneously toward the center of the gear face during the cutting stroke. The drive to the tool heads is through motor gear *9*, bevel gears *10*, *11*, *12* and *13*, worm drives *14*, and rack and pinion drives *15*. This mechanism provides the main planing stroke *AG*, Fig. 1, and is in fact the only motion when the machine is used for planing spur gears. For such work the tools

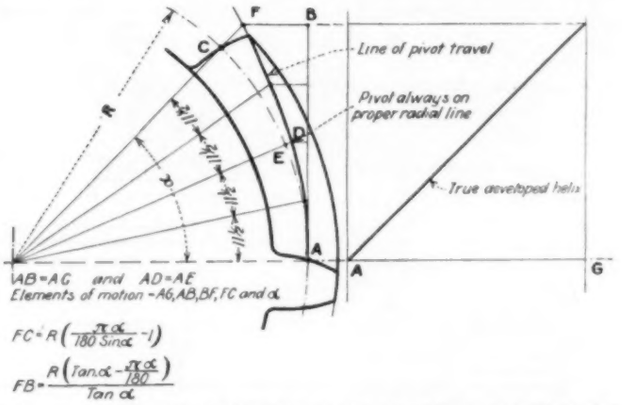


FIG. 1—DIAGRAM SHOWING HOW HELICAL MOTION OF CUTTING TOOL IS OBTAINED

are set to the proper height by running the vertical slides down against stops not shown on the drawings.

For herringbone gears the vertical motion *AB* is obtained by placing change gears having a ratio equal to the tangent of the helix angle, between drive shaft *16* and shaft *17*, referring again to Fig. 2. This shaft drives vertical shafts *18a* and *18b* through worm gearing *19*, and transverse shaft *20* through bevel gears *21*. A pinion *22* on this same shaft meshes with a rack on the vertical slide *4*, and thus gives the vertical motion.

The lower ends of shafts *18a* and *18b* drive shafts *23*, which carry the cams *24* working between rollers *25* and *26* and giving the transverse motion *BF*. This motion is very slight, and may in fact be eliminated for large gears, in which case the base *2* is bolted rigidly to the sole plates.

As the vertical slides move upward they impart motion to shaft *27* through a rack, and to worm shaft *7* through change gears, giving the angular motion a and keeping the tools radial with relation to the center of the work.

The tool heads, shown in detail in Fig. 3, are of the usual type, except that the slides are arranged so as to be in the line of the tool thrust and thus eliminate practically all spring. They are carried on compensat-

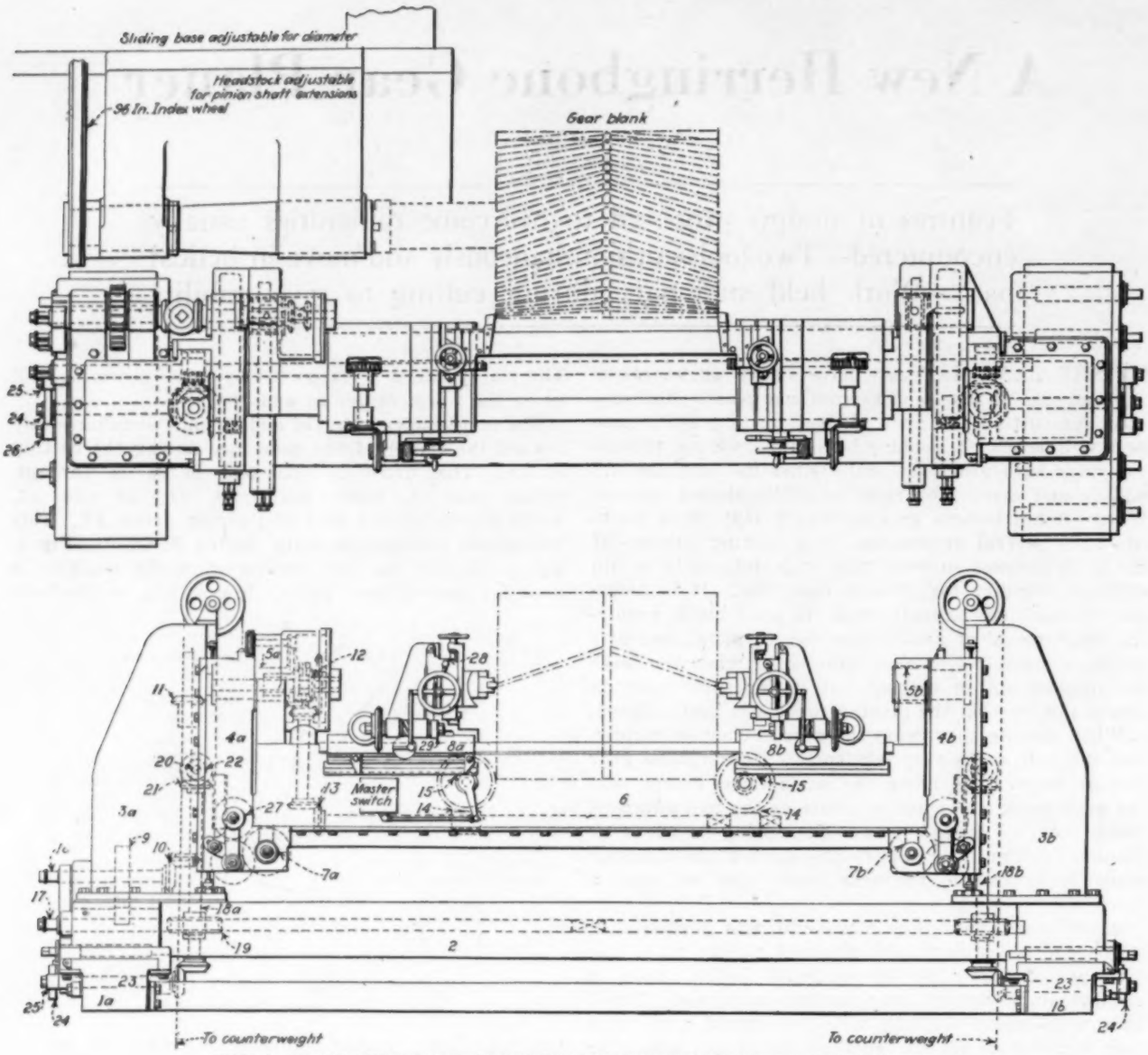


FIG. 2—PLAN AND FRONT ELEVATION OF HERRINGBONE GEAR PLANER

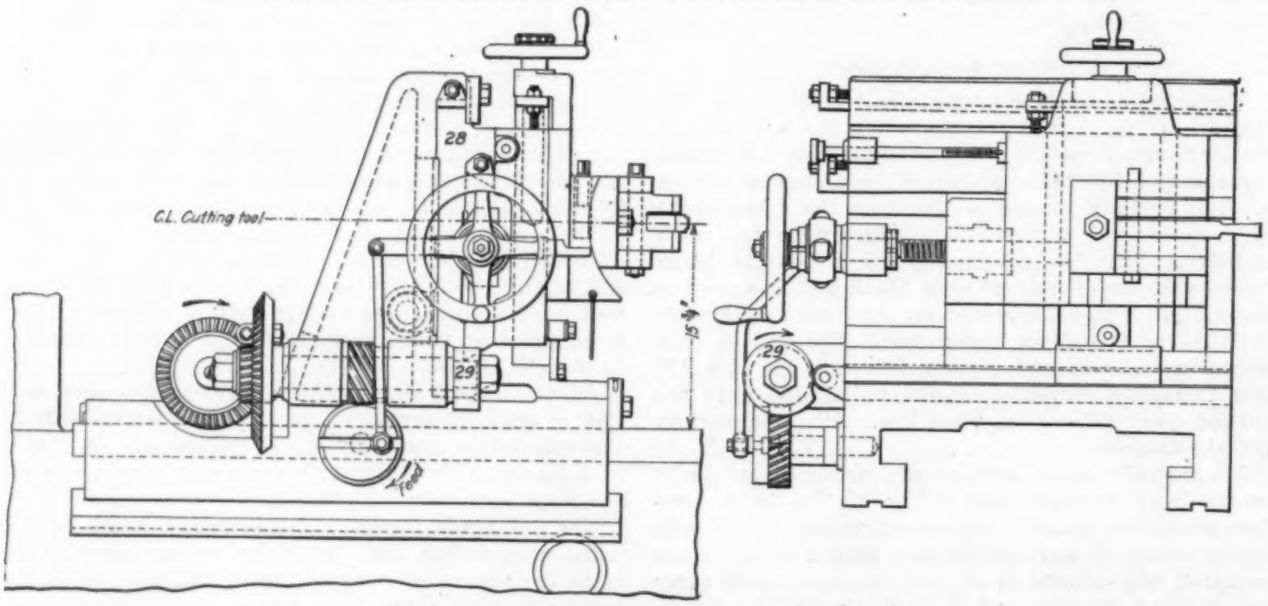


FIG. 3—FRONT AND SIDE VIEWS OF TOOL HEAD

ing slides *28* operated by cams *29* and giving the radial movement *FC*. The drive for this cam can be seen in the drawing. Since the cam must be on the zero line when the tool comes up to the face of the gear, an adjustment is provided. These cams are made in a series based upon diameters only.

The principal advantages of this machine, aside from the theoretical accuracy, are the rigid tool support close to the planer rail, the carrier drive on each side of the rail, which does away with binding and places the main driving force on the side directly under the tool, and a one-piece planer rail, which takes up the opposing tool thrusts. The planer rail constitutes a heavy balanced mass; but since its vertical motion is only about one-third of the longitudinal motion, or about 8 ft. per min., it follows that the inertia of this part has no serious effect. In this type of machine all adjustments for size of diameter and gear face are made by having the dividing head holding the work mounted on sliding bases.

It is confidently believed by the author that this machine will cut herringbone gears as readily as spur gears may now be cut with the best type of existing spur gear planer.

Bushed Versus Babbitted Bearings

By John S. Watts

SOLID bearings of all kinds may be divided into two types, one being the babbitted type, that is, bearings in which the babbitt is applied by being melted and poured into the bearing shell, and the other type being those which are bored out to receive a bushing of some anti-friction metal such as white metal or bronze, this bushing being machined both inside and out. For the purposes of this article, I will call the first type babbitted bearings, and the second type bushed bearings.

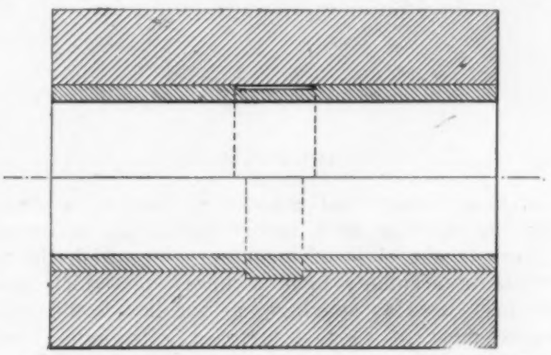
Both of these types have their virtues, and no one would advocate discarding either of them. But, we frequently find one type used where the other would have been more efficient, and I believe that there is room for a more general study of their respective merits. In a general way it seems that those who are most familiar with one type are very apt to use that type exclusively, without much if any consideration as to the merits of the other type for the particular purpose under consideration.

In order to make an intelligent choice of the best type of bearing for a given purpose, it is first essential to have an understanding of the merits and demerits of each type, which I shall now give in sufficient detail for that purpose. The babbitted bearing is much the cheaper in first cost, but that is the only point in which it is superior to the bushed type. When the babbitt is worn out, it is necessary to remove the bearing to chip out the old babbitt, and to re-babbitt it requires the services of a skilled mechanic.

A babbitted bearing should never be used where it will be necessary to dismantle the machine in order to line up the shafting when the bearings need to be re-babbitted, as the cost of this work will be far more than would have paid for bushed bearings, to say nothing of the risk of having the machine impaired by imperfect aligning. Where the bearing can be easily removed and replaced, and exact adjustment is not important, or if important is not difficult to attain, the babbitted bearing may well be the best one to use. But in such places as the main bearings of an engine, where re-babbitting will involve lifting out the crankshaft and dismantling almost the whole engine to get lines through the cylinder for lining up the bearings, the babbitted bearing is by far the most costly in the end.

The bushed bearing is quite a little more expensive than the babbitted, as it calls for more machine work. However, the first alignment of the machine is likely to be more perfect, as it depends only upon the accuracy of the machine work, and not so much upon the skill of a mechanic lining it up by hand. But what is, I think, more important, the machine can be kept in perfect alignment indefinitely by replacing the worn bushings with new ones. With proper care in the design, the work of fitting new bushings can be made much cheaper than it would be possible to re-babbitt the bearings, and the assurance of perfect alignment during the life of the machine is valuable to both manufacturer and user.

To attain the full economy possible from the use of bushings, the design should be such that the bushing can be removed and replaced easily. Especially in the case of heavy shafting the bushing should be removable without having to lift the shaft. There are many schemes used to prevent the bushing turning with the shaft, some of which call for more machine work than others, and, worse still, some compel the lifting of the shaft to get the bushing out.



SIMPLE CONSTRUCTION FOR A SPLIT BUSHING

The method I use for split bearings is shown in the accompanying sketch. The lower half of the bushing has a projecting flange at about the center of its length, which fits into a recess machined in the lower half of the shell. The cap, not having this recess, prevents the bushing from revolving, and the flange holds the bush from endwise movement. By lifting the bearing cap off and taking up the weight of the shaft on wedges or a jackscrew, the lower bushing can be revolved around the shaft one-half turn and then lifted out.

The recess shown cast in the upper half of the bushing makes it possible to machine the bushing as easily as if the two halves were alike; and it gives as cheap a construction to make as it is possible to obtain, and yet be effective for the purpose. The bearing shell is first bored out with the cap in place; then the cap is removed and the recess machined in the lower half, the whole making a very simple proposition for the machine shop.

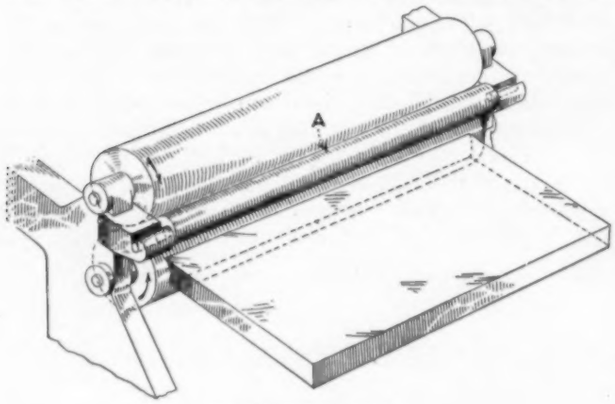
Ideas from Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for

An Efficient Guard for Rolling Machines

BY DONALD A. HAMPSON

Machine shop men are called upon to devise protecting devices for a wide variety of machines and machine tools. The requisites of an efficient guard are: first, protection; second, convenience for the operator. The highest type of guard combines these two features



GUARD FOR ROLLS

in such a manner that greater production is obtained from the machine than before the device is installed.

There is one class of machinery on which the most distressing accidents have occurred, on which guards have been used as sparingly as the law would permit, because most of them interfered with hand feeding operations. That class either has a pair of rolls geared together, or a single roll that runs inwardly in close proximity to a flat table. Such machines are found in large numbers in rolling mills, printing plants, and hundreds of process industries.

In all of this machinery, the workman is required to feed the material toward the line of tangency, very often having to guide the work well up to the rolls. It is here that a moment's carelessness results in his getting caught and maimed before help can arrive.

The drawing shows a type of guard that has been applied with signal success. The table is stationary in front of the rolls and upon it the work is laid and pushed up until gripped by the rolls. Fastened to the frame of the machine on each side are brackets, slotted to receive the journals of the drop-in roller *A*. This roller is free to revolve with the work, if it touches it as it is fed through. It does not retard production in any way.

But if the operator unconsciously runs his hands up too close, he finds them pressed by the weight of the roller. He has ample time to recover his senses before getting injured; at most he can only receive a passing scare, and the guard immediately drops into place again.

The simplicity and low cost of this guard commend it. In some cases the roller has been made of wood, five or six inches in diameter and weighing as high as fifty pounds; in others, where space and visability were demanded, a metal roller of lesser diameter has been used.

Spring Testing Machine

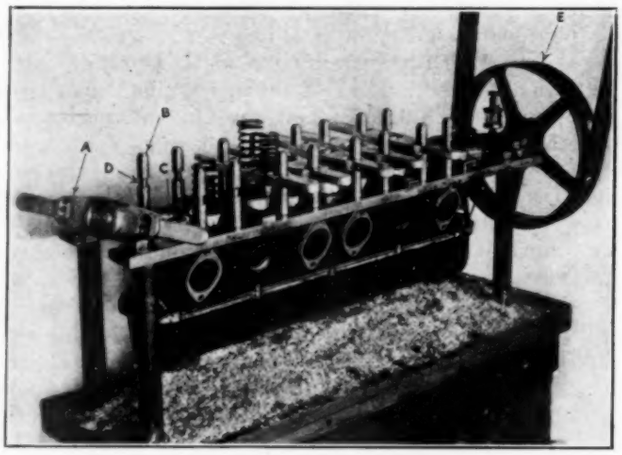
BY C. L. BURNS

The accompanying photograph shows a machine designed for subjecting helical springs to a service test before using them. It has a camshaft to operate moving spring-seats and a number of locking arms that impose upon the springs a pressure equivalent to that to which they will be subjected when actually in service.

The springs to be tested are placed on the seats as at *C* and the locking arms put over them and pressed into position on the locking posts *B*. The locking arms are provided with slotted holes which permit them to be slipped over the tops of the posts and locked in position on the shoulder *D*, by a slight twisting motion.

The machine can be made to test any number of springs required. In this case the springs were for an 8-cylinder gasoline engine and the machine accommodated eight sets of springs.

The driving pulley is attached to the camshaft which operates the spring seats *C*, through stems which are integral with the seats. The locking arms are provided with circular recesses on both sides. These



MACHINE FOR TESTING SPRINGS

recesses are made of such depths as to provide for two different lengths of springs.

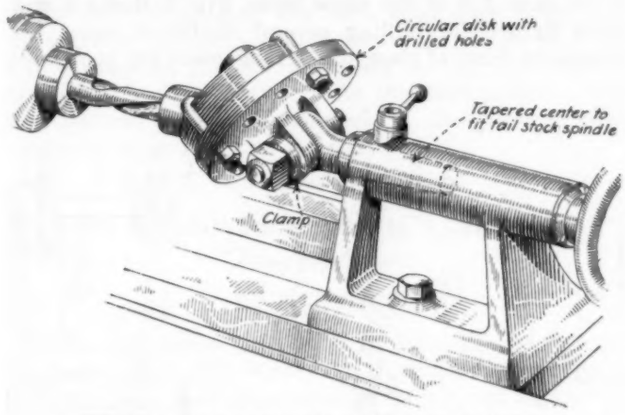
The important points to watch in the design of such machine are, the cam lifts and the distance between the bottoms of the recesses in the seats *C* and the tops of the recesses in the locking arms *A*, when the arms are pressed in position on the locking posts. These are factors which govern the pressure to be applied to the springs or the amount of compression that the springs are to receive. The speed of operation will depend upon service conditions.

A Useful Lathe Accessory

By G. A. Luers

A useful accessory for the small shop that is not too well provided with equipment, was devised by a local mechanic to take care of the drilling of some pieces that would ordinarily require a drilling machine (which he did not have) and a fixture for holding the work.

The piece is a tilting table to go in the tail spindle of



TILTING WORK SUPPORT FOR THE LATHE

the lathe, as shown in the sketch. A taper shank fitting the bore of the spindle is flatted off at the outer end to go between the lugs on the underside of the round piece that forms the table, and a cross hole through the two parts provides for a clamping bolt to fasten them in any required angular position.

Holes may be drilled and tapped in the disk for the purpose of clamping the work.

A Simple Tempering Kink for Small Parts

By William J. Thirkettle

We use at our factory steel rollers for guiding flat wire through cutters. These rollers revolve freely on centers as shown in Fig. 1, and are about 1½ in. long between the flanges. They are running continuously, in the operation of slitting with great accuracy thousands of yards of flat stock into narrow strips. Because of the nature of the work, the original wire must be of accurate and uniform width, and the measurement between the flanges of the roller also accurate, with as little chance for wear as possible.

Consequently, the rollers are hardened, and the small center pins also. We found that drill rod heated cherry red and quenched in cold water gave the desired hardness, but a difficulty arose owing to both the pins and the rollers breaking in the middle.

Different methods were tried, so as to temper only the extreme ends, but difficulty was met with the small pins, which were only ¼-in. stock and ½ in. in length. I thereby conceived the following kink that proved very satisfactory.

I obtained a piece of scrap cast iron about 2x3 in. in breadth and length and ½ in. thick, drilled and tapped six holes in the cast iron and screwed six of the small pins in these tapped holes, as shown in Fig. 2. I then heated the whole until cherry red and quenched quickly in cold water. The iron retained enough heat so as to leave the bodies of the pins comparatively soft, although the extreme ends were, of course, very hard. Up to the time of writing there has not been one case of a broken pin.

In the case of the rollers I used the same idea, with

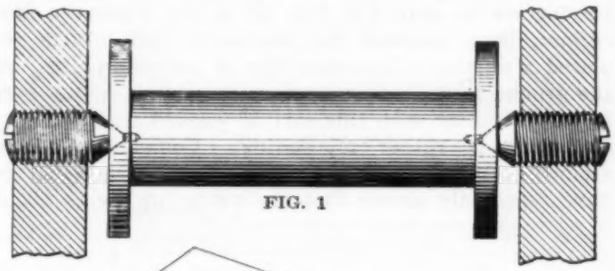


FIG. 1

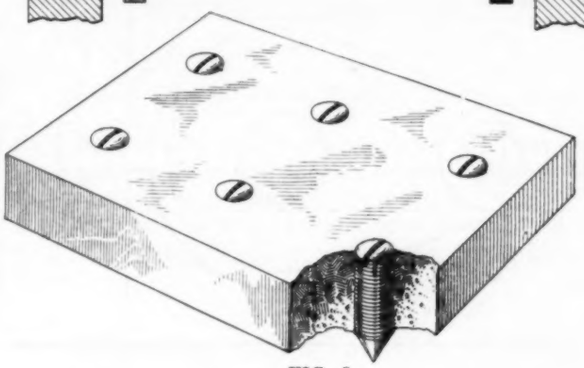


FIG. 2

FIG. 1—ROLLERS AND PINS REQUIRING HARDENING.
FIG. 2—MOUNTING PINS FOR HARDENING ENDS

a split cast-iron sleeve over the body of the roller. I am also using this method with tools that require hardening just in certain places. Cast iron proved the most economical and best metal to use for this purpose, owing to its peculiar properties when heated and quenched.

A Simple Expanding Mandrel

By C. H. Hays

Through an error, 2,000 die castings were delivered at our shop having square corners as at *A*, Fig. 1, instead of rounded corners as shown at *B*.

As the error had to be corrected by machining the castings, I made the expansion mandrel shown at *A*,

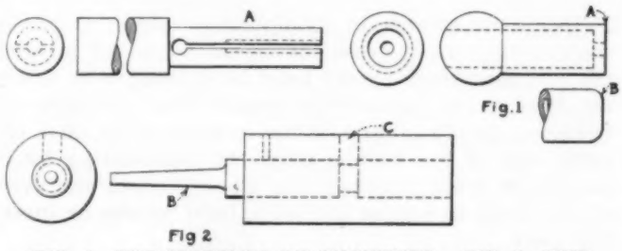


FIG. 1—THE WORK TO BE MACHINED. FIG. 2—THE EXPANDING MANDREL

Fig. 2, to hold them in the screw machine. The pin, *B*, for expanding the mandrel was held in a bushing in the turret and, while free to rotate with the mandrel, was held from moving endwise by a pin at *C*.

With this type of expanding mandrel, the castings could be put on and taken off without stopping the machine.

The pin for expanding the mandrel should be made of steel and hardened while the bushing should be made of bronze and provided with oil grooves.

Snapper Jigs vs. Swing-Top Jigs

BY GEORGE LAIDLER

In the article headed Reducing Costs and Increasing Production on page 418, Vol. 58, of the *American Machinist*, there appears the statement that a firm replaced a number of snapper jigs by swing-top jigs, on the ground that the former were too slow. As my firm is very familiar with this sort of work, I feel that this statement is rather misleading. Comparative time studies on similar pieces treated in both types of jigs have repeatedly shown that the swing-top jig is about 25 per cent slower, in manipulation alone, than the snapper jig. In one case the operator has but to raise the snapper bridge by the hand lever, remove or insert the work, while the drill or reamer need not leave its bushing. In the other case the operator must raise the drill clear of the bridge, undo the quick-acting latch, swing the bridge clear of the work, slacken the jaws of the chuck to release the work, then remove or insert the piece.

The snapper jig is most convenient for work not requiring the greatest accuracy, such as can be centered readily under a bell-mouthed bushing or held between flat surfaces. The swing-top jig, while undoubtedly slower, is extremely accurate; moreover, one such jig when fitted with suitable removable bushings will accommodate quite a number of similar pieces of work of different bores, outside diameters and heights. On changing work from snapper jigs to swing-top jigs, our experience has been that scrap due to faulty drilling or reaming has been almost eliminated.

An assembled snapper or spring pressure jig applicable to the hardening of the bore of dies for the cold-drawing of shafts is shown in Fig. 1. Here the red-hot die is held under spring pressure between asbestos pads while a stream of water passes through the central hole. In Fig. 2 is shown a swing-top jig which embodies a standard three-jaw chuck. In disengaging the latch *A*, the first turn or so on the star wheel *B*, releases the pressure on the latch. On further turning, the star wheel jams on the washer *C*, held by the inserted screw, and turns the latch into the free position.

On page 419 of the same issue, Fig. 5 shows a multiple fixture for milling several shafts at once. An improved form of clamping arrangement for such work

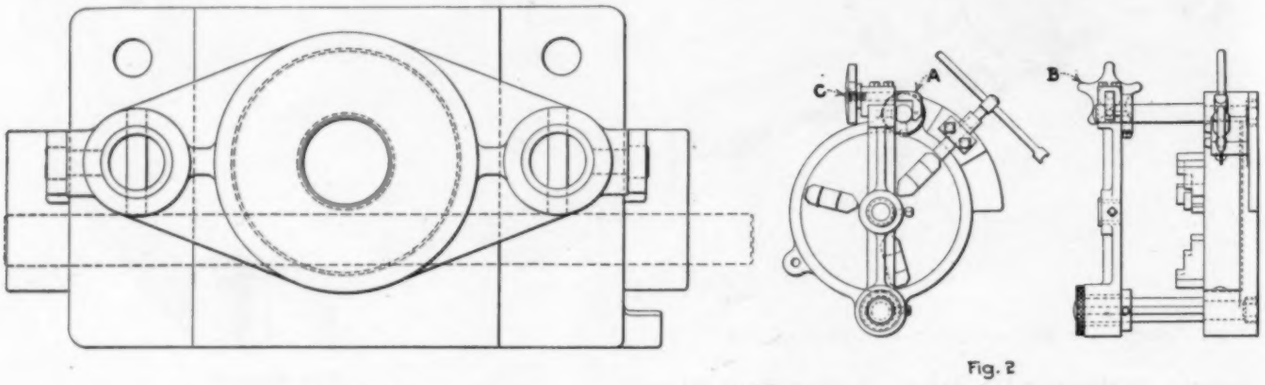


Fig. 2

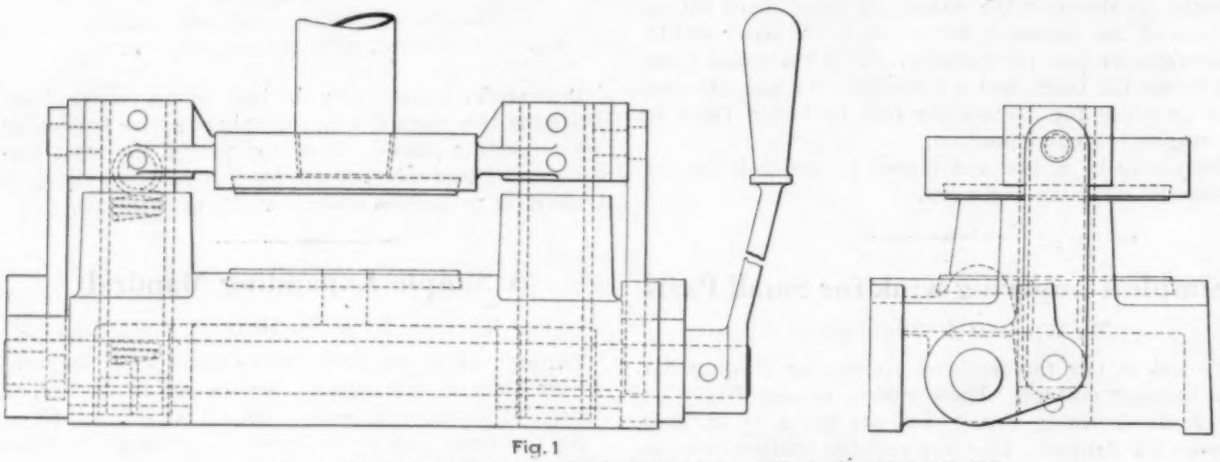


Fig. 1

FIG. 1—SNAPPER OR SPRING-PRESSURE JIG. FIG. 2—SWING-TOP JIG.

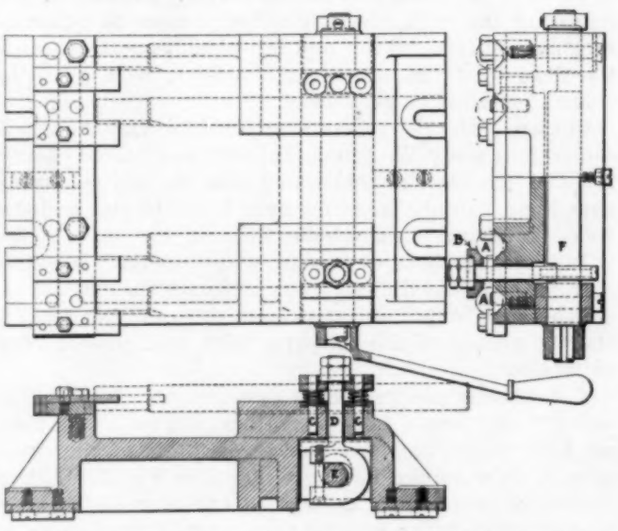


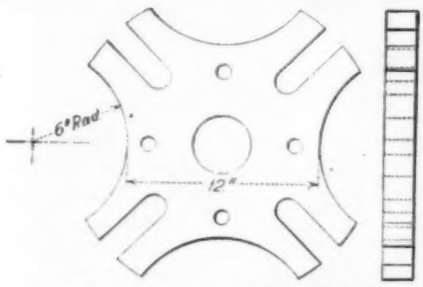
FIG. 3—FIXTURE FOR HOLDING WORK IN MULTIPLE

is illustrated herewith in Fig. 3. Here each pair of shafts is held by a clamp *B*, normally held up by springs around two guide pins *C*. The inclined edges of the clamp are cut at 40 deg. to the horizontal, the sides of the V being at 45 deg. By this device a very slight lift of the clamp allows the shafts to be removed sidewise and upwards. The clamping pressure is obtained by means of a bolt *D*, shaped as shown, which engages the eccentric portion *E* of the stiff cross shaft *F*. This shaft is 1⅜ in. in diameter in the main, reduced to 1 in. at the eccentric portion, and has a hand lever at one end. Adjustment for various diameters of shafts is made by the locknuts on the clamping bolt, so that the work is located when the eccentric is on the dead center. This arrangement has been applied to the simultaneous clamping of as many as six shafts.

An Improvised Milling Cutter—Discussion

By F. Jaeger

Under the above title on page 808, Vol. 58, of the *American Machinist*, Henry M. Clary describes how a lathe tool was used as a substitute for a milling cutter to do a facing job in the milling machine. A somewhat similar application has been made in the shop where I am employed. The work is shown in the accompanying sketch, the operation being the machining of four concaved surfaces to a radius of 6 inches. The piece was held on the dividing head of a Cincinnati milling machine by passing four bolts through the holes shown, the holes being necessary to the design of the machine and not made specially for the purpose of holding the piece.



PIECE MILLED WITH ARMSTRONG TOOL

An Armstrong tool holder was gripped in the regular three-jawed chuck supplied with the milling machine and adjusted to the required radius. The dividing head was set to face the column of the machine and the regular cross-feed applied to advance the work to the cut.

Careless Assembly and Lack of Balance

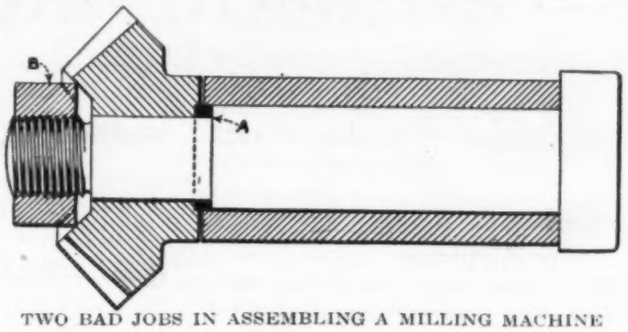
By Henry C. Francis

We bought a new milling machine the other day and it had the worst "hump" in the elevating works that I've ever seen. Once every revolution the handle bound so we could hardly get it past the tight spot. So we took it apart and found about as bad a job as I've seen for some time.

The back of the bevel gear bore on the housing before the nut could be tightened, as shown at *A* in the sketch. We fixed this by puting in a washer back of the gear and bearing on the shoulder, so as to give a clearance of about 0.005 inch.

Then we found that the nut would not tighten the gear down square because the corners of the nut bore on the bevel inside the teeth as shown at *B*. By putting a large chamfer on the corners of the nut, as shown by the dotted lines, so it would bear on its face, the job was finished.

On this same machine we had to balance the cone,



TWO BAD JOBS IN ASSEMBLING A MILLING MACHINE

by adding about 1½ lb. of weight on one side, before we could run it at the higher speeds. This is a very common fault with many of the machines we get. It is surely a poor way to let a machine go out, and we would certainly hesitate before buying the same kind next time.

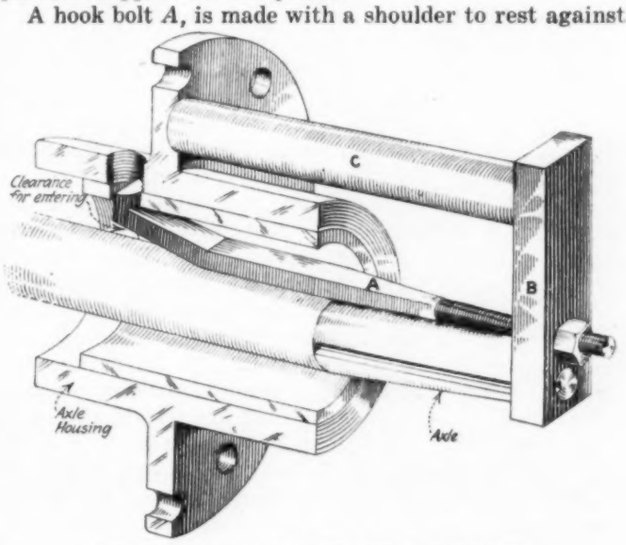
A Bushing Puller for Axle Bearings

By G. A. Luers

Where the roller type of bearing is to be replaced, it is advisable to renew the sleeve bushing at the same time, as this constitutes part of the bearing.

To remove the bushing without disassembly of the axle parts, a local mechanic devised the special puller shown. The use of this puller avoids the interference of the axle and in fact makes use of the axle as one point of support for the puller.

A hook bolt *A*, is made with a shoulder to rest against



PULLER FOR AXLE-BEARING BUSHING

the axle. To use the hook bolt it is tipped up and the end enters the recess in the bushing which is provided for the retaining screw. A cross bar *B* is provided with two holes, one of which is threaded to screw over the end of the axle, while the other is plain, for the hook bolt. A short bar *C*, is used to support the outside end of the cross bar. A nut on the threaded end of the hook bolt makes a screw jack for pulling out the bushing.

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Editors

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The Use of Metal In Airplanes

IN almost every change in transportation methods we have seen in initial developments the use of wood in structure whenever possible, and then noted its abandonment for metals—in shipping, railways, bicycles, automobiles and now the airplane. The dirigible is perhaps the only exception.

Those of us who have followed aircraft closely look back and shudder at the early contraptions in which men risked their lives in their enthusiasm for the development of the new science. No pioneers ever dared more for science than the early fliers who courageously explored the unknown air currents in machines built of wood or bamboo, fastened in the crudest manner, and braced together with wire of unknown strength. How these machines ever held together will always be one of the unsolved mysteries, and it is little wonder that very few of the original fliers are still with us.

Slowly but steadily, however, the use of metal has forced its way to the front. First in the shape of fittings by which the wooden struts and beams were held together, but gradually extending to other parts of the structure. Several of the pioneers, such as Sturtevant, attempted metal construction early in the game. And though they did not entirely succeed they aided in the development of aircraft. Others have followed and by degrees the use of metal is growing, although less rapidly than would be the case were airplane manufacture an established industry, for wood lends itself to small quantity production better than metal.

Many have contributed to the use of metal in airplanes, both in this country and abroad. The German Junker, the Fiat and others are doing their share in its development. And it is with no spirit of discrimination that we single out the recent work of the Aeromarine Plane and Motor Co. as an example. Its latest development is the all-metal hull for flying boats, which has many advantages over the wooden construction. The hull is lighter, does not add weight by absorbing water, and while it may be dented, it does not splinter or leak as easily as the wooden hull. The useful carrying capacity is increased and the cost of maintenance is less. The lighter weight enables a ship weighing 6,000 lb. to carry a useful load of 2,445 lb. and to "take off" or rise from the water in much less distance than the wooden hull. The same company has also developed a metal mail-plane.

The increasing use of metal in aeronautical construction brings the industry more and more into line as a user of machine tools and other metal-working machinery. And from a purely business point of view, cities in which such machinery is built should be progressive in providing landing fields, beacons and other necessary adjuncts for aerial transport. Some can make provisions for land machines and others for sea planes but all can encourage the industry in one way or another. It is the next step in transportation and those who are wise will aid its development in every way possible.

Sending Out Unbalanced Machines

THE letter on page 567 regarding defects in newly purchased machine tools, has one very significant statement which shows that not all tool builders are alive to the needs of fast-moving spindles and other parts. We refer to the statement regarding the lack of balance in spindles of high-speed machines.

We have talked much of balancing revolving parts to eliminate vibration. But there is still much to be done in the balancing of high-speed spindles and shafts for steady running and for the production of accurate work.

It is decidedly discouraging to buy a machine which is supposed to aid in economical production by running drills or milling cutters at high speed, only to find that, through faulty workmanship and lack of knowledge as to proper balancing, the spindle cannot be run at over half its maximum speed. Such an experience is very apt to result in placing the next order elsewhere.

With the knowledge of balancing which we have acquired during the past few years, and the machines which are now available for this work, there is little excuse for sending out high-speed machines out of balance. Machine builders who desire to maintain a reputation and to continue selling to users whose work demands high speed and who appreciate a first-class job, must consider running balance. Proper balancing is as essential as good fits in bearings and good materials in all the parts of the machine.

The Eight-Hour Day Attracts Workers

IT USUALLY happens that when we are contemplating a change in business policy or shop management, we overlook at least one important factor. And this in spite of the fact that we fondly imagine that we have carefully canvassed every factor which has a bearing on the case.

A good recent example of this is the reluctant establishment of the eight-hour day, instead of the twelve, in the steel industry. After making elaborate plans to secure such additional men as might be needed, it soon became apparent that there was no need whatever for worry on that score. The eight-hour day itself made the steel mill sufficiently attractive to men in other lines, to secure their applications for work almost immediately.

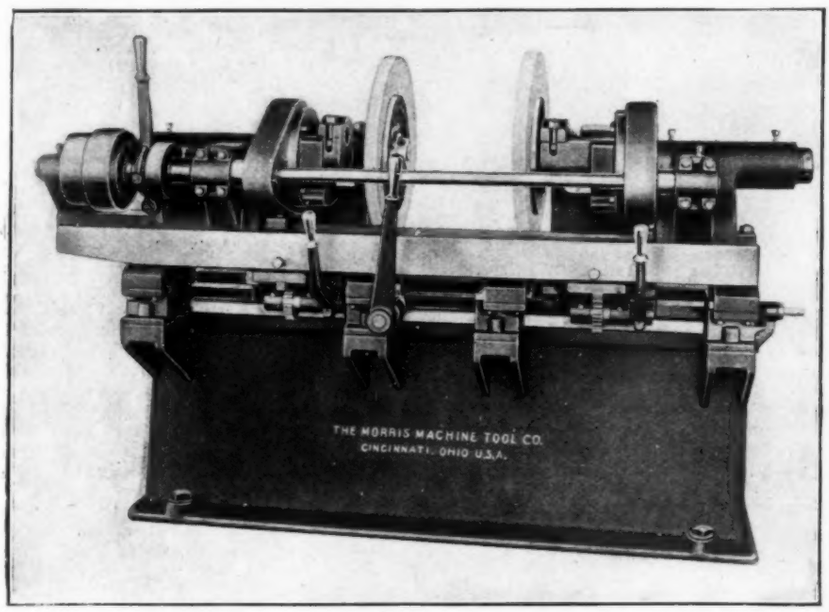
Evidently we have not quite reached the point where we fully realize that the shop worker is not a part of the machinery but that he has the same desires, likes and dislikes as the rest of us who work in other lines. When we fully realize this we shall get on faster and many of our present shop problems will disappear.

Shop Equipment News

Morris Crankshaft Buffing Machine

For the purpose of polishing crankshaft bearing surfaces after grinding, the Morris Machine Tool Co., Court and Harriet Sts., Cincinnati, Ohio, has recently placed on the market the crankshaft buffing machine shown in the illustration.

For continuous production three machines are required to buff a four-throw crankshaft complete. Two machines of the type shown in the illustration buff the crank pins, each buffing the two pins on the same center. Another machine, similar to the one illustrated but furnished with three wheels, holds the shaft between centers and buffs the main bearings. A six-throw crankshaft requires four set-ups.



MORRIS CRANKSHAFT BUFFING MACHINE

In the crank-pin buffing machine illustrated the shaft is mounted on an offset chuck and driven from both ends, in a manner similar to a crankshaft turning lathe. For buffing the main bearings the shaft is driven from one end.

The buffing wheels are made of hard felt about 24 in. in diameter and pulverized glass, dressed with a crocus block from time to time, is used for a polishing material. It is stated that the polishing operation does not change the diameter more than 0.001 in. The wheels are mounted on ball bearings in slides which are arranged to be moved transversely through the manipulation of the two short levers, shown at the front of the machine.

The table which carries the shaft driving heads can be moved longitudinally by means of the long lever. The wheel slides are adjustable on the bed to suit crankshafts of different sizes.

The driving heads are driven from the two-step cone pulley at the left of the machine, and a lever located nearby controls a friction clutch and brake. The wheels are enclosed in dust hoods which can be connected to a dust collecting system. The weight of the machine is approximately 6,000 pounds.

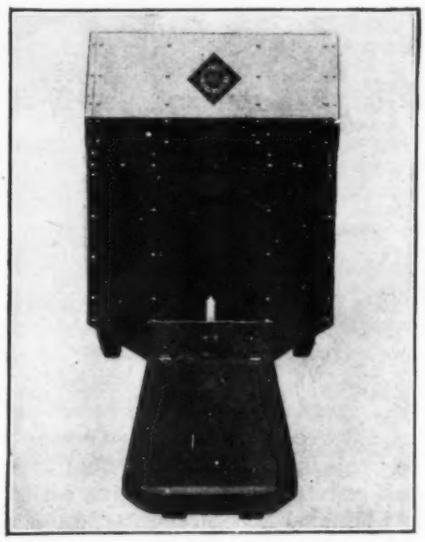
It is claimed that these machines will polish bearings faster than can be done by the hand method and with much better results. Crankshafts buffed in this machine are said to show superior wearing qualities and obviate running in the bearings in the finished motor.

Elwell-Parker Electric Low Lift Truck

For the purpose of handling material with greater ease and rapidity on load platforms, such as used with a hand lift truck, the Elwell-Parker Electric Co., Cleveland, Ohio, is now marketing a low type electric lift truck.

This truck has a riveted steel frame and the standard electric motor and drive. The drive wheels are 22x3½ in. and are rubber tired. The frame is supported over the drive axle by springs, and the storage battery is located in a compartment directly over the axle. It is claimed that the motor is of sufficient capacity to drive the truck with its load up a 10 per cent incline.

The wheels beneath the platform are 5¾ in. in diameter and 4 in. wide. The top of the platform is made from ¼-in. steel plate. The platform is 18 in. wide by 46 in. long,



ELWELL-PARKER ELECTRIC LOW LIFT TRUCK

is 6¼ in. above the floor in its lowered position, and has a lift of 3½ inches.

The platform is supported on three links which are pivoted on the frame. The lifting is done by means of a combined rocking and elevating motion of the platform, actuated by a screw ram attached to the rear of the platform between the links. The

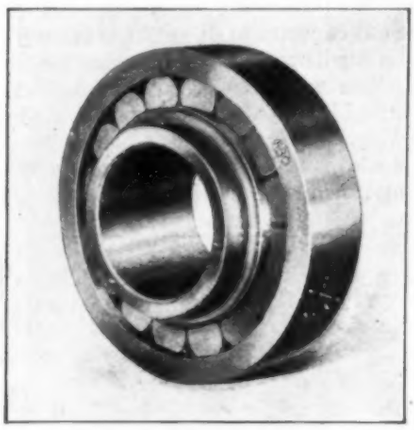
screw is threaded into the hub of a worm wheel which is driven through a steel worm by an independent motor.

When the lifting switch is closed, the mechanism lifts the load 3½ in. in 10 sec. and stops automatically. All four wheels steer, thus giving the truck sufficient flexibility for operation in restricted spaces. It is claimed that a 4,000-lb. load can be transported at from 300 to 400 ft. per minute.

Rollway MDW Type Roller Bearing

A recent addition to the line of roller bearings manufactured by the Rollway Bearing Co., Syracuse, N. Y., consists of the MDW type which has been developed for heavy service such as heavy gear or chain drives, railway service, and work of similar character.

The inner race of this bearing is



ROLLWAY MDW TYPE ROLLER BEARING

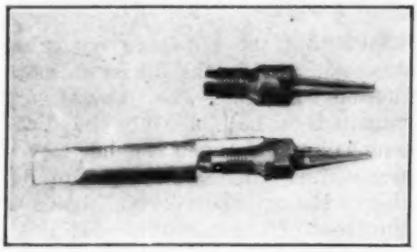
wider than the standard bearing, the extra width being intended to obviate the tendency of narrower types to cut into the shaft, and to make unnecessary the extremely heavy fits usually recommended for such heavy service equipment. The lighter fit makes removal of the bearing easier.

The inner and outer races are of a heavy channel section as shown in the illustration and no separator is used between the rollers. The use of the maximum number of rollers is therefore possible. The rollers are held from slipping end-wise by the sides of the races.

Both races and rollers are made from high-carbon, high-chrome steel. The bore diameters for the various sizes range from 0.7874 to 10.2363 inches.

Circular Tool Co. Profile Cutter

The Circular Tool Co., 71 Willard Ave., Providence, R. I., has just placed on the market a line of profiling cutters, commonly known as "cutter plate mills." The threaded shank of the mill is purposely made



CIRCULAR TOOL CO. PROFILE CUTTER

a loose fit in the collet and the tool, therefore, takes its bearing against the conical under surface of the shoulder. By this means, which is equivalent to the hold of a draw-in chuck, it is claimed that the tools are accurately centered and much more firmly held.

The tapered tools, one of which is shown in the illustration both in and out of the standard collet, are furnished in standard sizes ranging from $\frac{1}{16}$ to $\frac{1}{4}$ in. in point diameter, and from $\frac{3}{4}$ to $1\frac{1}{4}$ in. in length of flute. Parallel cutters are supplied in diameters ranging from $\frac{5}{16}$ to $\frac{1}{2}$ inch.

"Python" Ratchet-Action Wrench

The Python Tools Co., 95 Liberty St., New York, N. Y., is now marketing a ratchet-action general purpose wrench.

As shown in the accompanying illustration, the tool consists of a hollow handle from which projects a length of chain. At the end of the chain a suitable hook-shaped link is

"PYTHON" RATCHET-ACTION WRENCH

provided which fits over projections at the end of the handle after the chain has been wrapped around the part to be turned. When adjusted in this manner the end of the chain is locked in the handle by the manipulation of the thumb lever shown.

The adjustment is rapid and easily accomplished. For handling unions and similar parts where the force required is not too great, the capacity may be doubled by hooking on the extra chain shown in the illustration.

The wrench will grip nuts, rods, pipe or fittings of hard or soft material or with rough or smooth surfaces. The ratchet action makes it convenient in close quarters, and it is claimed that the chain grip will not mar the surface to which the wrench is attached.

Decrease in Iron and Steel Exports

August exports of iron and steel products from the United States were 163,010 long tons, compared with 170,259 tons in July and the monthly average of 164,535 tons for the first seven months of 1923. A comparison of the detailed figures by the Iron and Steel Division of the Department of Commerce for August shows exports of pig iron and structural, fabricated and unfabricated, to be respectively about 20 per cent and 25 per cent greater than the average for the eight months ending Aug. 31, and wire rods 37 per cent; wire and wire products, 25 per cent; plates and sheets 25 per cent; and bars, 12 per cent less than the monthly average for the period.

The United States imported 45,612 tons of iron and steel products during August, compared with 53,448 tons in July and the monthly average of 81,323 tons for the first seven months of 1923.

Pig iron, ferro alloys and scrap showed the greatest falling off, compared with the previous month's receipts as well as with the monthly average for the eight-month period. Imports of semi-finished steel, rails, and plates showed most marked increases.

Chinese Markets Get Japan's Orders

The effect of the Japanese disaster on Chinese markets was immediate, says Commercial Attaché Julean Arnold in a cable from Shanghai to the Department of Commerce. Japan's emergency purchases have stimulated the market, after some months of dullness, into marked activity and Japan's temporary cessation of exports has materially increased China's foreign trade.

Steel stocks in Shanghai are reported depleted and there is a good demand for stocks needed to replace the amounts sent to Japan. Shanghai is reported buying from several sources. Orders are being placed in America for tubing and galvanized sheets; in Belgium for plates, shapes, and angles; in England for galvanized sheets and nails; and in Australia for nails. Japan's temporary cessation of exports to China, it is expected, will increase the demand for American cotton, piece goods, steel and machinery

News Section

Fall Meeting of Machine Tool Builders Association Is Held at Lenox, Mass.

THE general approval of everything connected with the second Autumn meeting of the National Machine Tool Builders' Association at Lenox, Mass., seems to indicate that this affair is an annual fixture. The time of this year's meeting, Oct. 2 to 4, found the Berkshire Hills and golf courses at their best. Sixty-five member companies were represented by more than 140 executives and their wives.

In setting aside the mornings of the first days of the meeting for official golf and tennis, the program committee showed excellent judgment as attendance at afternoon sessions was but little reduced by unofficial indulgence in these pastimes. Another move that was productive of good results was the placing of three rows of rocking chairs in front of the meeting room. As a result it was unnecessary for President Kearney to ask those in the back to move forward.

At the Tuesday afternoon session the outstanding feature was the presidential address of E. J. Kearney. We expect to publish the complete text in an early issue. There was also a report by Wallace Carrel for the joint conference committee of the builders' and dealers' associations. After relating the facts regarding machine tool distribution as brought out in its investigations, the committee made the following recommendations:

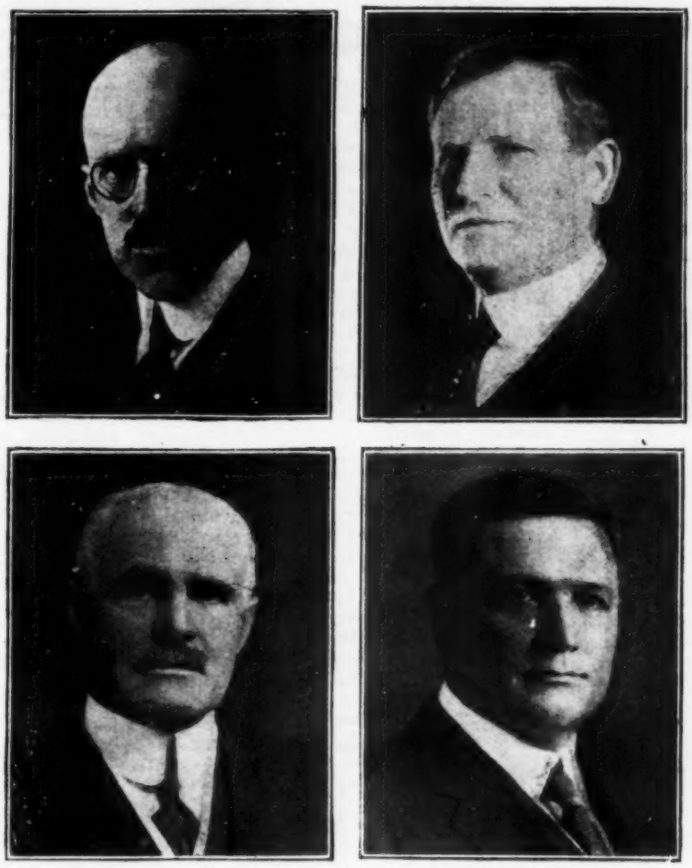
"It is the hope of the Committee that a comprehensive statistical service may be conducted on some plan that will give the market the best sort of information. By the market, the Committee wishes to be understood as including users as well as dealers, agents and manufacturers. In the past all elements have suffered serious losses from the lack of good statistical information. Buyers have not learned to forecast their need for equipment, and too many place their orders just when costs and, of course, prices are the very highest.

The Value of Statistics

"Good statistics would enable the sellers of machine tools to demonstrate that this policy is wasteful and economically unsound. With such statistics some buyers could be influenced to place more orders than they now do in times of depression, just when the sellers need orders the most.

"The present buying policy of large users throws a peak load on machine tool builders at most inopportune times, and it is greatly to the industry's interest to take every step that will get more orders into the valleys and less on the peaks. Costs, direct and indirect would thereby be greatly reduced, and the buyer would not have to invest so much capital at high prices as he does under his present methods of buying. Complete stabilization of demand will of course never be possible, but every step in that direction will benefit the whole market.

"Without statistical facts available the industry will continue to suffer the most violent fluctuations of any industry. With investment of over 200 millions of dollars at stake, of machine tool builders' capital, and the additional millions invested by distributors, it is certainly worth while to spend considerable sums of money on the betterment of buying practice."



UPPER LEFT, R. E. FLANDERS, PRESIDENT; UPPER RIGHT, O. B. ILES, FIRST VICE-PRESIDENT; LOWER LEFT, FRANK N. MAC LEOD, SECOND VICE-PRESIDENT; AND H. M. LUCAS, TREASURER

In his report, General Manager E. F. DuBrul called attention to the fact that there had been a slight recession in orders since the last meeting. Mr. DuBrul also told of recent developments in the field of technical research both in the machinery industry and in other fields. After some discussion of this phase of association activity the president was authorized to appoint a committee to look into it and report back at the next meeting.

At the evening meeting, H. M. Lucas, chairman of the Ethics Committee, presented an important progress report for discussion. It was referred back for further consideration by the committee.

By far the most important event of the whole meeting was Fred A. Geier's 100-yard putt with a mashie for a birdie three during the course of a match at the Pittsfield Country Club. Had Mr. Geier joined the Hole-in-one Club the excitement could not have been more intense. This famous stroke will live long in the annals of the association, and deservedly so.

The championship golf cup was won by Major MacLeod of the Abrasive Machine Tool Co. of Providence, R. I., who defeated Mr. Neilson of the Norton Co. by 3 and 2. A cup presented by the Hotel Aspinwall was won by Mr. Swift of the Ohio Machine Tool Co. who beat Mr. Whipp of the Monarch Machine Tool Co.

O. H. Broxterman of the John Steptoe Co. proved to be the master tennis expert when he defeated H. K. Spencer of the Blanchard Machine Co. in the finals after a hard fought match.

The following new directors were elected: R. E. Flanders, Jones & Lamson Machine Co.; J. G. Benedict, Landis Machine Co.; H. P. Dix, Wilmarth & Morman Co. and H. M. Lucas, Lucas Machine Tool Co.

Upon organization of the new board of directors these officers were elected: President, R. E. Flanders; first vice-president, O. B. Iles, International Machine Tool Co.; second vice-president, Frank N. MacLeod, Abrasive Machine Tool Co.; treasurer, H. M. Lucas.

Many Sales to Small Consumers in Pittsburgh Market

For several weeks past the big companies have been rather slow in buying machinery and machine tools in the western Pennsylvania district, and many of them are absent from the market altogether. Disappointment is felt that the railroads are not buying more prolifically, but surprise was also expressed when it was seen how well the roads were meeting the heavy shipments of the steel mills and yet having many surplus cars left. This indicates that they are in better shape than was thought, and the car repair shops are not operating as heavily as in previous months. This has caused a let-up in demand for machine tools in that particular line.

However, the trade is heartened by the individual tool inquiries from small consumers, a distinct increase along this line being noticed in the past ten days. Sellers are encouraged, and expect to close up a number of deals shortly that will put a different aspect on their business conditions. A few of the steel companies have sent out inquiries in the last few days for machinery, the Pittsburgh Crucible Steel Co. being among this number.

A sale of cranes was noted a few days ago, and attention was called to the number of inquiries coming from different parts of the state for cranes. The Carnegie Steel Co. closed on fourteen jib cranes with the Whiting Corp. The Northern Engineering Works, Detroit, took an order for a three-ton electric overhead traveling crane from the Lorain Steel Co., Johnstown, Pa.

The inquiries coming are for practically all kinds of tools, but chiefly lathes, drill presses, wheel presses, etc. A dealer reported the sale of a motor-driven pipe machine, a saw, three motor-driven drills to one buyer, and four drills to another buyer. The Pennsylvania R.R. is expected to ask for revised bids on inquiries that have been current for some time for work east of Altoona, Pa., as well as for equipment at the repairs in the Sharpsburg shops.

Intermittent buying of good used machinery continues, among the sales lately being that of a 42-in. vertical boring mill and a 30x16-in. lathe. A local manufacturer bought a milling machine, and the same seller reported the sale of two small drills and other small equipment.

Business Improves in Canada

The machine tool business is enjoying a satisfactory share of the general improvement of trade in Canada. The expansion of the automobile industry and a considerable increase in the volume of car and other rolling stock construction has provided a broadening market for tools, forgings, etc. Western Canada particularly is opening up well from the standpoint of the machine tool trade. British Columbia is reported to be in good shape, due to the revival of the lumbering and mining industries; and the likelihood of the continued need of lumber in the Far East is thought to be a factor in guaranteeing a continuance of this condition. Such activity is making a broad market for tools.

The production of pig iron in Canada during August showed an increase of 13 per cent over the previous month, while the tonnage of steel ingots and castings produced during August was the highest for any month during the present calendar year. The revival in the demand for steel products has grown out of the renewed activities of general commerce in this country and with the increasing needs for transportation, consequent upon expanding industrial development, continuance of the favorable progress in the steel industry may be expected.

Money Plentiful in Canada

Development in regard to new purchasing power from agriculture and other primary industries continues to be most satisfactory, while the response to the recently floated Dominion refunding loan of $172,000,000 is an encouraging indication of the financial stability of the country. The Western crop is already on the move. Eastern trade centers report a better movement of goods. The distribution of about $25,000,000 in October dividends should add impetus to the demand for merchandise as well as proving an important factor in the investment situation.

A substantial increase in Canada's trade is shown in the figures for the twelve months ended with August. The total trade for that period was $1,892,928,000, an increase of $381,000,000 over the preceding twelve months.

There is also much to be thankful for in the recent statement of the Canadian National Railways for the month of August, which shows a considerable increase in net earnings of the system. Gross earnings are shown to have increased $1,566,123 or 7.7 per cent, as compared with August, 1922. After deducting operating expenses, which amounted to $19,940,909, a net operating revenue is shown for the month amounting to $2,027,000 as compared with a net operating revenue of $1,036,894 for the corresponding month of 1922.

Milwaukee Expects Good Month

While the progress made by the demand for foundry and machine shop equipment since midsummer has not been equal to expectations, manufacturers and dealers find encouragement in the improvement in business that has taken place in the early part of October. There is a hesitancy about purchases and an irregularity with respect to buying sources which still prevails and makes the state of trade not as satisfactory as general opinion expected it would be by this time. Business lacks zest and it requires strong selling pressure to get buyers to take hold.

The automobile industry, which was the backbone of trade in machinery during the past twelve to sixteen months, has not resumed purchases on the same liberal scale noted during last Spring, and it is questionable if large lots will go into this channel for the present, save for a comparatively few large and outstanding interests which have been the mainstay of trade since the gradual decline in sales began late in the Spring. The call for equipment for railroad shops remains disappointing, but this is now an old story and no further predictions of a highly optimistic character are being issued in any quarter.

Production Good

Judging by the manner in which manufacturers of metalworking machinery are sustaining their shop operations on at least the top of the level established during the past year, it would seem that while trade appears to be quiet on the surface, there must be a moderate quantity of business passing. At the same time, such shops maintain standing orders for help.

Milwaukee, a center of the mining machinery and equipment industry, profited materially from the presence a short time ago of several thousand members of and delegates to the American Mining Congress. It is stated that representatives of concerns in Mexico placed orders valued at more than $250,000 with Milwaukee equipment shops. The Pawling & Harnischfeger Co. received an order for the largest type of its excavating units, the success of which in operation will control the purchase of numerous additional units in prospect. Otherwise no notable instances of large individual orders have been reported, although other concerns in this market admitted an accentuation of business during and since this occasion.

The city of Milwaukee is preparing to establish a central machine and general service area for all automotive and other municipally-owned equipment within the coming six months and while no official lists have been issued, it is understood that a fair-sized lot of miscelleanous tool and other equipment will be purchased.

New York Selling Used Tools

Very little actual buying is evident in the New York market this week. The Delaware, Lackawanna and Western R.R. and the New York Central R.R. were both in the market for a few tools, but there have been no lengthy lists issued by the roads and no buying of more than single tools. Some little purchasing is noted among the automobile manufacturers, but dealers state that this is not up to expectations either.

The two bright spots in the current market are the purchasing of heavy machinery by general industrials and the good demand that is existing for used tools. The used tool market was exceptionally lively during the past seven days, but there were no indications of how long this condition would keep up.

While September proved to be a poor month from the actual total of sales, during the first part of the month there were many inquiries and hope is still held out for actual sales during the month of October.

Exporting has improved during the first week in October with several big sales reported.

Production in Buffalo at Good Rate and Sales Improving

The Buffalo machine tool market is considerably better than it was thirty days ago, although heavy equipment is still rather dull and there is sharp competition and many inquiries for second-hand equipment. Most of the business in the smaller lines is coming from small manufacturers. The bigger plants are slow in buying at the present time.

Most reports indicate that manufacturers are somewhat pessimistic, but it is a significant fact that the great majority of them are working full time and many of them overtime. There is no doubt that part of the pessimism is due to the slow collections of the last few weeks which, for some unknown reason, seem to be much slower than usual. Banks here, however, do not expect that this condition will continue long. It seems to be due to the vacation season and the fact that in this locality there has been a rather constant expansion in nearly all lines.

Reports from the Buffalo Forge Co. indicate that buying has not been as heavy in its diversified line during the last few weeks as formerly, but there are orders on the books to keep the plant running full time with full personnel for two months. One line has been unusually good. That is the tools exported. There has been a heavy buying movement in its export lines, particularly in supplies for blacksmiths, such as forges, blowers and the like. Most of these sales are going to Australia, New Zealand and South Africa, in which this company has had connections for the last forty years.

This company also reports that the railroads are still buying. It recently sold a bar cutter for 4-in. rounds to the Pere Marquette R.R. and a cut-off shear for flat stock to the same company. The Reo Motor Car Co. recently purchased a bar cutter for 4-in. rounds.

The Wheeler-Murray Co. states that there is a good demand for contractors equipment. Business is considerably better than last year at this time and the prospects for the Fall are very good. There has been a steady increase in inquiries and sales in the last sixty days.

Henry Prentiss & Co. find that the tone of business has gradually improved during the last few weeks. The only quiet factor is that which has to do with the automobile and automobile accessory line, some plants reporting that they are working only one-third time. This is not considered as important at this time because of the problems in manufacture, such as that dealing with the four-wheel brake. It is expected that as soon as such problems are solved and policies definitely determined upon that the automobile line will be even better than last year.

Conditions Steady in St. Louis

Increase in the number of inquiries being received by machine tool manufacturers in St. Louis and the healthy condition of business in general would indicate that midsummer predictions of a better Fall trade would be fulfilled. But these prophecies have not come up to expectations. Buyers of machine tools are buying just what they absolutely must have and are not putting into effect the plans for expansion which they had in mind. These plans are in the making or are perfected and when put into practice will require the purchasing of machine tools.

Railroads are buying, as they have for the past several months, for pressing needs only. The oil industry of the Southwest is still out of the market.

Concerning conditions in this district during the past thirty days, the Federal Reserve Bank survey states: "General business in this district during the past thirty days was featured by slight improvement over the similar period immediately preceding, and as contrasted with a year ago the gains of recent months were well maintained. The acceleration was due in part to seasonal considerations, but according to reports of a majority of leading interests in all lines scattered throughout the district, the principal factor favorably affecting the situation was a distinct improvement in expectations of the business community for Fall and Winter trade."

The statement concerning the iron and steel industry reports: "New bookings during the period under review were sustained at or slightly better than the rate of the similar period just preceding. There has been a decided improvement in the volume of inquiries directed to manufacturers and jobbers, and the character of the inquiry is indicative of reduced stocks and actual need of the tonnage specified. Job foundries and specialty makers have received a fair volume of new orders, and are extending their commitments for raw materials. Buying by the railroads continues on a liberal scale, and the automotive interests are also accounting for heavy tonnages of materials going into that class of construction.

"Steel plants specializing in railroad castings are operating at capacity, and have orders which will insure the present pace for the next 60 to 90 days. A further decline in buying of drilling and oil working supplies was reported."

Railroad Lists Out in Chicago

Thus far October has not shown any improvement in the volume of machine tool sales. The Burlington R.R. has postponed its purchasing on its large pending list from time to time, but now makes announcement of an intention to purchase this week. The Rockford Lathe & Drill Co., Rockford, Ill., has bought three milling machines, a horizontal boring mill, and two radial drills. The American Maize Products Co., Hammond, Ind., has purchased a second-hand 6-ft. radio drill and a 60-in. boring mill. The Chicago, Burlington & Quincy R.R. has placed an order for a 20-ton overhead electric traveling crane for its West Burlington shops. The Southern Pacific Co. has purchased an axle lathe and a 6-ft. radial drill. The New York Central R.R. has purchased an engine lathe. The Chesapeake & Ohio Ry. is reported to be in the market for a 20-ton locomotive crane.

The metal trades continue production in satisfactory volume and Chicago dealers believe that buying will gradually return.

Iron and steel bookings showed a slight increase during the last week, but the average for September was below August. A number of the U. S. Steel Corp. subsidiaries and several independents reported a gain in business last week, but the orders were not sufficient to bring the average for September up to August. Production by the leading interest registered a gain of 1 per cent during the week.

Detroit Business Is Good

A gradual settling of business conditions to a normal Fall basis is the outstanding development of the past week in the machine tool industry in Detroit.

The slight pick-up in production and market noticed in September at the close of the vacation period has established industry on what careful observers believe will be the basis for the next two months.

Further changes in automobile models and announcements of the 1924 models featured the past week. Price reductions in several lines have also become effective.

Freight movements on all the railroads show a decided increase, according to reports. For several weeks the received shipments have been heavy, although the outbound movement was somewhat off. This is thought due to the stock-taking season which obtains generally at this time of the year. The indications are now that September freight movement will exceed that of March which holds the record for the present year.

Employment figures, which have hovered around the 215,000 mark for some weeks past showed a decrease during the week ending Oct. 2, according to figures of the Employers' Association which shows 214,590 employed, a decline of 1,383 from the 215,973 figure of the previous week.

Building construction is likely to hit a new high figure for the year. All construction work is being speeded to completion before the advent of colder weather.

Executives in the machine tool plants of the city are anticipating a fair business during October and November with a seasonal decrease in December.

New York University Has Industrial Course

"The Human Equation in Strikes" might well be the name of a new course on Labor and Employment which is being offered at New York University this year for the first time. J. D. Hackett, an experienced consultant on labor problems for many large manufacturing concerns will have charge of the course.

J. B. Doan Hurt in Auto Accident

While motoring from Syracuse to Schenectady Saturday, Sept. 29, J. B. Doan, president of the American Tool Works Co., Cincinnati, Ohio, Albert E. Robinson, plant manager of the American Tool Works Co., W. H. Birdsall, manager of the Syracuse Supply Co., Syracuse, N. Y., and Samuel Stevens, a capitalist of Rome, N. Y., were severely injured when the automobile in which they were riding skidded and turned over twice on an embankment near Schuyler, N. Y.

Mr. Doan and Mr. Robinson were on their way to New York previous to their intended attendance at the meeting of the National Machine Tool Builders' Association held at Lenox, Mass., Oct. 2, 3 and 4. Mr. Birdsall, whose firm represents the American Tool Works Co. in the Syracuse district, had offered to take them to Schenectady in his new enclosed car that had been driven less than 800 miles.. In turning out for another automobile Mr. Birdsall's car plunged down an embankment. All four of the occupants were rushed to the hospital at Utica, N. Y., where it was found that Mr. Doan was suffering from shock and a laceration of the scalp, Mr. Robinson from bruises about the body and possible internal injuries, Mr. Birdsall from abrasions about the face and Mr. Stevens from a badly cut left ear and lacerations on the hands and leg. While none of the injuries were of a serious nature, they were severe enough to confine Mr. Doan, Mr. Robinson and Mr. Stevens to the hospital for more than a week.

A telegram of sympathy was dispatched to Mr. Doan by the members of the National Machine Tool Builders' Association in which it was regretted that he was unable to attend the meeting and expressing hopes for a rapid recovery.

Personals

WALTER V. LAWTON has been appointed district manager for the Boston district, with headquarters in the Textile Building, for Manning, Maxwell & Moore, Inc., New York City.

W. H. JELLY, heretofore connected with the office of the eastern Pennsylvania district of the United American Metals Corp., at Philadelphia, has been transferred to Pittsburgh, where he will manage the sales of babbitt metals and bushing bronze in the western Pennsylvania district.

JOSEPH WAINWRIGHT has been appointed sales manager in the Philadelphia district with headquarters at the Pennsylvania Building, for Manning, Maxwell & Moore, Inc., New York City.

LEE H. LANDIS of San Francisco, Calif., has been named general manager of the Alaska Railroad by Secretary of Interior Work.

W. C. CHAPMAN has been appointed district manager for the Philadelphia district, with headquarters in the Pennsylvania Building, for Manning, Maxwell & Moore, Inc., New York City.

Business Items

The plant of the Pittsfield Machine Tool Co., Pittsfield, Mass., consisting of five acres of land, a large brick building and smaller buildings, has been sold to the Eaton, Crane & Pike Co. The plant was built in 1908 by Alden Sampson for the manufacture of automobiles.

The Aetna Foundry & Machine Co., Warren, Ohio, has been acquired by the Shenango Machine Co. of Sharon, Pa., which concern will operate it in conjunction with the Warren plant. The Warren plant will be used for the production of blast furnace steel mill castings. The two plants will have a capacity of 800 tons and will employ 200 men.

Expansion of the Homer Engineering Co., Canton, Ohio, is announced by F. A. Carlisle secretary and general manager of the concern. Additions to the plant and installation of new machinery will result in the plant's capacity being almost doubled. Additional grinding machinery is being installed. Machinery also is being installed to manufacture a sheet metal specialty. A blacksmith and forging department will be a new feature.

Work of removing the pipe machinery manufacturing departments of the Columbus Machine Works to its new home at Crothersville, Ind., has been begun. The removal will take a week or ten days, and by Oct. 15 it is expected that the department will be in operation. Other departments of the machine works will remain at Columbus until the first of the year.

The Moore Drop Forging Co., with plants in Springfield and Chicopee, Mass., has acquired the Page-Storms Drop Forging Co. at Springfield, by a quitclaim deed transferring all properties and the right to use the Page-Storms name. The Moore company had previously acquired a large part of the stock in the smaller concern. It took over the Page-Storms Chicopee plant two years ago, and has made expansions consisting of three different additions at a total cost of $180,000. An increased business has been done in the manufacture of automobile parts.

The Norma Co. of America has placed contracts for the erection of the first unit of its new plant upon the property recently acquired at Stamford, Conn. The plant will be equipped for the manufacture of Hoffmann precision roller bearings, the American rights to which were recently acquired from the Hoffmann Manufacturing Co., England.

An addition to the core room and foundry of the National Radiator Co., New Castle, Pa., recently completed, has increased the capacity 25 per cent. A shortage of men is all that keeps the plant from working full time on current orders.

The Cheswick plant of the Peerless Sand Co., Pittsburgh, Pa., which was recently damaged by fire, will be rebuilt soon, according to plans. The loss sustained was $90,000.

Equipment and materials belonging to the Belcher & Taylor Agricultural Tool Co. plant of Bateman & Co., Inc., at Chicopee Falls, Mass., have been disposed of at auction and the sale of buildings and land was set for a later date. The equipment and materials went to different purchasers.

Fire recently destroyed the one-story frame factory building of the Amco Manufacturing Co., Indianapolis, Ind., manufacturers of shock absorbers and accessories for automobiles. Officials of the company said the loss might reach $100,000. The fire apparently started in the shipping room in the rear of the factory building. The machinery used in the manufacture of shock absorbers was destroyed.

Officials of the Atlantic Coast Line Railroad Co. have advised that a contract will be awarded within a few weeks for the construction at Montgomery, Ala., of new machine and equipment shops to cost approximately half a million dollars. When completed the new shops will about treble the capacity of the present Montgomery shops. James A. Bowdoin is superintendent of the branch at Montgomery.

The old Miramichi Foundry & Machine Works at Chatham, New Brunswick, will in the future be operated under the name of the Miramichi Foundry Machine Works, Ltd., the new company planning a greatly extended business program which will take in bridge construction.

Two new Wisconsin corporations have been organized by identical Milwaukee interests to engage in the manufacture of tool steel and tools. The Jolite Co., Inc., of Milwaukee, with a capital consisting of 1,000 shares of common stock having no par value, is chartered to engage in the manufacture and treating of high speed steel. The Jolite Tool Co. of Milwaukee, is to manufacture and design tools of all descriptions. The incorporators in both instances are Dean R. Williams, George M. Wolff, Curys L. Cole, Winfield S. Nussbaum and John Last. Headquarters are being established in the plant and warehouse of Williams, Cole & Wolff, Inc., manufacturers' agent, 610 Sycamore Street, Milwaukee.

The Arctic Ice Cream Co., Detroit, has purchased from the Commerce Motor Car Co. the plant and real estate embracing four acres of ground at Green, Mackie, Solvay Aves., and the Wabash Railway. Walter E. Parker, president of the Commerce Motor Truck Co., announces that all tools and equipment have been purchased by that company, which is a re-organization of the Commerce Motor Car Co., and that the business will be continued.

Obituary

W. H. BALDWIN, formerly secretary of the Ohio Steel Co., before the formation of the U. S. Steel Corp., died recently at his home in Washington, D. C. Mr. Baldwin was well known in the iron and steel industry before his retirement in 1901.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By THEODORE H. PRICE
Editor, *Commerce and Finance*, New York

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THE week's business developments were all of a nature to strengthen the cheerful confidence with which most far sighted men view the outlook for Fall and Winter trade. Short sellers on the New York Stock Exchange at last found that prices could not be depressed further and the resulting covering movement advanced quotations quite sharply. This in itself was as void of significance as the decline which they had previously caused, but its influences on the temper of those whose dispositions are largely governed by the course of stock prices was most salutary. It obliterated the bewilderment and hesitation which was developing because one of the business indicators was pointing in a contrary direction to most of the others, and there was an audible sigh of relief as the market swung around in harmony with trade reports.

Second in importance was the continued strength in prices of the chief agricultural products. Corn sold at over a dollar in Chicago, the highest price in three years, and as the December future is quoted at 75 cents there is every reason to expect very high prices for the new crop also.

Hogs and cattle, too, have scored and held sharp advances from the year's low prices. Good times in the Central States therefore seem assured.

Cotton has withstood the shock of a crop report considered in excess of most guesses in a manner which leaves no doubt that spinners have little hope of getting their supplies much lower than at present. In parts of the belt the farmers are selling freely, paying their debts and increasing their bank deposits. The prosperity of the South is not a matter for conjecture, since it has already arrived.

Reports from the California fruit crops and the Northwest lumber markets all indicate that the remarkable affluence of the Pacific Coast will be undiminished, since the yield of the former and demand for the latter both promise to be unusually great.

The sugar producers of the West and of Louisiana will market larger crops than last year at virtually the highest prices of the season. Manufacturers are buying more wool than in some time, and hides and leather, long laggards, are at last looking up. Even the one-crop wheat farmer of the Northwestern states, the most ill-starred of our producers, is better off than seemed likely two months ago, for wheat is some 15 cents higher than it was then and the market is steady. Furthermore, the outlook has been improved by the action of President Coolidge in sending Directors Meyer and Mondell of the War Finance Corporation to the central Northwest to direct the formation of co-operative marketing associations among the wheat growers, to which loans from government funds will be made. By some this will be regarded as an unwarranted extension of government activity, but the fact is more important than the theory.

As for the manufacturing sections, there is no unemployment to speak of and payrolls are uniformly very high, so high in fact that the buying power of labor in terms of commodities is probably the largest it has ever been in our history. And while it is to be expected that payrolls will be decreased to some extent during the Winter there is no reason to believe the cuts will go far. Enough building is in progress and planned to assure more Winter employment of the building trades than in any other year except last year.

> "As for manufacturing, there is no unemployment to speak of and payrolls are uniformly very high, so high in fact that the buying power of labor in terms of commodities is probably the largest it has ever been in our history . . . . The General Motors Corp. expects to turn out more cars in October than in any month of its history. There is no reason to look for any cut in railroad payrolls as their Fall traffic is almost sure to break all records."

The usual curtailment will be enforced in automobile production, but automobiles are now priced at very attractive levels and the General Motors Corp. expects to turn out more cars in October than in any month of its history. There is no reason to look for any cut in railroad payrolls, as their Fall traffic is almost sure to break all records and since the "Big Four" brotherhoods are asking wage increases which they have an excellent chance of getting if they will agree to certain changes in working rules.

The short time of some textile mills and the shut down of the Amoskeag gingham mills have occasioned some pessimistic talk, but the condition of the markets is almost a guarantee that curtailment will not become epidemic. Production in all lines, in fact, while below the peak of the year, is still far above 1922 levels and promises to continue so.

Out of such fecund soil bountiful business easily grows. Trade continues everywhere heavier than last year. Mail order stores report a 25 per cent increase. The hardware trade makes a like statement. Dry goods business is excellent. Many lines have not been marked up to a parity with raw cotton and distributors realize that there is little hope of getting goods cheaper. I hear talk of "resistance against higher prices," but it will be time enough to consider that when higher prices develop. Meantime retail trade seems to be good everywhere.

Copper shows no improvement, and iron and steel production is declining somewhat, but consumption continues high, coming needs appear great enough to supply the mills with good Winter business and now that Judge Gary has said that prices will not be cut in the near future, buying will probably be accelerated. Indications are multiplying that the oil flood has begun to recede and the markets may soon recover from their inundation.

Money rates are slightly above average because our huge trade is naturally making heavier demands, but the banks are financing business without having much recourse to the Federal Reserve Banks and there is no danger that all requirements cannot be easily supplied. The Federal Reserve statement shows a reserve ratio of 75.8 per cent. With such untapped resources behind them there is no doubt that the crop movement can be handled without strain, particularly as the agricultural banks have not yet felt the expansion of credit as much as the industrial banks and the sharp decline in flotations of state and municipal bonds has reduced a hitherto steady drain on the country's capital.

The news from Germany superficially has appeared even more depressing than usual, but from the standpoint of its influence on business, the worst happened in Germany long ago. No European nation drifting into republicanism could hope to escape years of unrest and periodical outbreaks, but business in general goes on "as usual." In this case that phrase may not mean much, but at any rate there is no further cause for pessimism.

Steel Institute Will Meet Oct. 25

The American Iron and Steel Institute will hold its twenty-fourth general meeting Oct. 25 at the Hotel Commodore, New York City. Following addresses by Elbert H. Gary, president, papers on various topics connected with the industry will be read by Col. T. C. Dixon, Dr. F. C. Lagenberg, F. B. Quigley, C. L. McKenzie, John L. Cox and Chung Yu Wang of Hankow, who will speak on the iron and steel industry in China. Following the banquet a special train will be run to Aberdeen, Md., where the institute will hold a joint meeting with the Army Ordinance Association.

American Salesmen Successful in Foreign Markets

BY PAUL WOOTON

IF AMERICAN-MADE goods are to be exported, Americans first must be exported.

This is paraphrasing the words used by a French senator in admonishing the producers of his country of that essential step in the securing of export trade.

Both England and France long have practiced such a policy. While they do not equal the Germans in that respect, the urgency of their present need for additional markets is resulting in the dispatching abroad of unusual numbers of their own nationality.

American firms frequently make the mistake of selecting as their representative, people of the nationality of the country in which they are establishing the agency. Even in England and France, where men trained in the particular line are available, results generally will be more satisfactory if an American is sent. This applies to France as well as to England, despite the handicap of language. It would be better to send an American who has been brought up with the product, even if he has no knowledge of the French language. This is the opinion of the most intelligent observers in that country. The average buyer, particularly of machine tools or other articles of relatively large first cost, wants to deal with a man who knows the product. He wants to be acquainted with the details of the tool as applied in American plants similar to his own. He wants to ask a hundred questions which only a man from the home office can answer. Moreover, the American would be able to convince, where well justified statements by a Frenchman would fall short of that mark. Literally hundreds of examples can be cited in France to substantiate these views.

The chances are that the American will not be long in acquiring enough of the language to do a good deal of talking for himself. Half of his prospective customers will speak English.

The usual procedure among the representatives of foreign houses in France is to secure the services of a capable French assistant who knows English. He acts as interpreter when the necessity arises and in addition is in charge of administrative matters in the conduct of the office.

AMERICANS IN FRANCE

One of the most successful salesmen of machinery ever sent to Paris was an American representing a company manufacturing a widely-used special purpose machine. On his arrival, his knowledge of French was confined to the motto of the Order of the Garter. Even at the time of his death, many years later, after a remarkable record of sales, his knowledge of French was very imperfect. Not all the American machine-tool makers, however, had that much vision. Before the war, some of them were represented in France by Germans.

An actual case illustrates the point further. An American machinery manufacturer had a French agent. Sales averaged ten machines per year. A man who had been associated with the business for a long time finally was sent to Paris to succeed him. The company soon had to build an addition to its plant to take care of the business he secured. No such results, however, should be expected in France just at this time, particularly in the matter of machinery as only essential purchases are being made, due to the unfavorable rate of exchange.

What has been said of the French situation can be applied equally well to any other country and the principle works out almost as well with canned salmon as it does with machine tools and allied lines.

Depreciated currencies work against the sale of British products as well as against our own. Despite this fact, they are sending out men to all parts of the world with the idea that they are to take up permanent residence there. Frenchmen already are conducting one or more drygoods stores in cities and towns throughout the world in countries in which they have natural markets. They are rapidly extending the policy to many other lines and in many parts of the world.

Comparative Prices of Shop Supplies

Average of New York, Chicago and Cleveland Prices

	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0337	$0 0337	$0.0292
Cold finished shafting	per lb.	0.0433	0.0433	0.0378
Brass rods	per lb.	0.165	0.17	0.171
Solder (½ and ½)	per lb.	0.262	0.276	0.2283
Cotton waste	per lb.	0.1225	0.1225	0.1458
Washers, cast iron (½ in.)	per 100 lb.	4.66	4.66	4.33
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.08	3.08	2.96
Lard cutting oil	per gal.	0.575	0.575	0.575
Machine oil	per gal.	0.349	0.349	0.36
Belting, leather, medium	off list	37%	37%	44½%
Machine bolts up to 1x30 in.	off list	49½%	49½%	49%

Improving the Lincoln Plant

A large portion of the machinery in the Lincoln plant of the Ford Motor Co., Detroit, is being gradually moved to new locations in order to provide greater room for departments now cramped. Moving of the several departments into a new addition, which increases the plant floor space by 311,000 sq.ft., is being carried on under a plan which provides that raw materials and stock shall enter one end of the receiving room and pass slowly through the manufacturing processes to emerge at the other end of the building as finished products. Conveyor systems, new and improved machinery and many other facilities are being installed.

Increase Shown in Canadian Trade

In a summary of Canada's trade with the United States for the twelve months ending with August this year, prepared by the Dominion Bureau of Statistics, the total value of machinery imported into Canada from the United States is shown as $24,506,646, an increase of $3,789,000 over the preceding twelve-month period. There was a slight increase in the value of tools purchased in the United States, the figures being $1,589,427, as compared with $1,102,718. The total value of vehicles imported from the United States was $28,788,183, being an increase of $3,654,000. The principal item in this group was passenger automobiles, which totalled 10,119 valued at $10,322,386, as against 9,945, valued at $10,724,555 in the preceding twelve months.

Automobile parts also figured largely in the expansion of the United States trade with Canada. The total imports of parts were valued at $14,691,777, as compared with $11,626,407.

The most important item under this heading in Canada's exports to the United States is engines, represented by a value of $2,389,912, as against $61,985 during the previous twelve months. There was a slight falling off in the value of farm implements exported to the United States viz: 1922, $1,129,184; 1923, $1,055,914. Canada sold to the United States during that period 153 passenger automobiles as compared with 106 in 1922.

Canadian Locomotive Elects New Head

The Canadian Locomotive Co., Ltd., of Kingston, Ontario, has unfilled orders to the extent of $2,300,000, it was announced at the annual meeting. The plant has enough work on hand to keep it running well into next Spring. F. G. Wallace of Pittsburg, resigned the presidency and Amelius Jarvis of Toronto was appointed to succeed him, also retaining the chairmanship of the board. Mr. Jarvis pointed out that there had been a shutdown of the plant for over twenty months and that very little profits from the new business had entered into the current year.

Despite this the operation profits, together with the income from the investments, has enabled the company to show an operating profit for the year of $7,400 over the charges for the shutdown period.

Modern Machine Tools and the Thrifty French

How American machine tools have been introduced into France—Competition with domestic products and German tools—France's awakening to its mineral wealth predicted

BY OUR PARIS CORRESPONDENT

THE French machine tool trade is today feeling outside competition less than ever before. American, British and Swiss tools are checked by the handicap of high dollar, pound and gold franc exchange rates and the German mark has become so unstable as to be no longer, at least temporarily, a factor.

A reasonably low priced mark should have been Germany's opportunity, but when the bottom all but dropped out of the mark the very uncertainty of production, delivery and price at delivery date did the rest. More than 50 per cent of the value of the machine tools imported into France in the year before the war were of German origin.

Undoubtedly, in the years immediately following the armistice, a considerable quantity of German machine tools, indeed metallurgic productions of all kinds, drifted through the "Hole of the Saar," which the makers of the Versailles treaty forgot or neglected to provide against.

This, of itself, should not have worked detrimentally for French production so far as was foreseen by all but an enlightened few, nor for imports from the United States, since German heavy machine tools were at that time taxed for customs' dues at the rate of 64 francs the 100 kilos while those from America paid but 16 francs per 100 kilos. In reality, however, it did, as was even then noted by those who visioned the steadily falling mark while French customs' dues remained constant. German prices at the source were jacked up (in paper marks) from time to time, but never so rapidly as to catch up, least of all pass the 64 francs a hundred kilos limit.

German and American Prices

In 1920 a German turret lathe sold on the Paris market, according to the statement of a representative handling American, French and German lines, for 30 per cent less than a similar American article, and even then the French product was another 30 per cent under in price. A steadily falling mark upset this formula, but also a falling franc with respect to the dollar (10 francs to the dollar at that time as against 18 to the dollar at this moment) subverted calculations with regard to the American product with the result that today no foreign made machine tool commonly to be had in open stock in Paris can compete in price with the French commodity. When it competes at all it sells itself on merit, by reason of some inherent superiority of fabrication or operating efficiency, not by any means on the price issue.

Born of the war, of the reconstruction period and the general progression of France as an industrial nation, tools and machines of all kinds are certainly more in demand, more in use than ever before. For a considerable period after the war, the French buying public was absorbing all manner of left over American war stocks, from electric cranes to refrigerating machinery, from lathes, borers and millers to motor trucks and locomotives. French finances would not allow of cash being sent beyond the frontiers, hence the French machine tool trade, among all the branches of metallurgical industry, got a flying start in so far as any innovation may be said to roll up in big waves in France.

Imports of "machines and machinery" and "tools and hardware" (to give them their French customs classification) from the United States decreased 150 million francs during the first six months of 1922 while the same elements exported from France to the United States increased 700 per cent. The entire exports of French machine tools of 1920-21 exceeded those of 1913, the year before the war, by 180 per cent.

> "When all is said and done, there is little hope of a drawing together of prices of American and French machine tools so long as the wide divergence exists between the dollar and the franc. Besides which the French manufacturers are one and all protectionists and if there is any immediate or remote juggling with the French customs tariff it will result rather in a revision upward than downward."

Francs and Dollars

The extreme fluidity of the situation as it now is prevents any definite estimate as to when and how conditions will improve, but inasmuch as the tendency of the dollar is to rise, exports from its country of origin to a country whose monetary unit is the depreciated franc, are bound to decrease and imports—up to a certain point—increase. This is an axiom; the marvel is that the motives thereof are so often neglected or ignored.

Manufacturing costs are high in France and usually production along most metallurgic lines is high grade, or was. Latterly, however, they have been producing more popular grades of tools in point of price and finish—another effort to hold at home a proportion of that business which, before the war, so greatly went to Germany. This comparison can hardly be made with respect to America though before the war the American product offered in the French market while not as cheap as that of Germany was usually rather lower in price than a similar French article, and better.

When all is said and done there is little hope of a drawing together of prices of American and French machine tools so long as the wide divergence exists between the dollar and the franc. Besides which French manufacturers are one and all protectionists and if there is any immediate or remote juggling with the French customs tariff it will result rather in a revision upward than downward.

Big business is becoming more and more efficient in France by the adoption of machinery for the accomplishment of many operations which were formerly done by hand, and by higher speed, more efficient tools replacing those of a mediocre output. Automaticity plays its part, but there is big work ahead to do in this line.

Labor Difficulties

French labor in point of numbers is at a lower ebb than ever and the eight-hour law has cut off another 20 per cent. It has not been French experience that the workman will produce as much in eight hours as in ten, no matter how he may be encouraged or stimulated.

Potential sales are shown by the fact that France is bound one day or another to find the way to make use of its magnificent and extensive siderurgical industries by employing raw and semi-finished products for fabricating at home instead of shipping pig iron to the Pacific coast or strip steel to England to have it come back to France in various manufactured forms. With such an argument it is small wonder that the French machine tool makers have taken on the post war spurt that they have. More than two hundred French makers of machines and tools continually keep their advertisements before the readers of the technical and lay press, covering most forms of wood and metal working machinery and such accessories as are intimately related thereto.

One virgin field that as yet scarcely has been touched by the French manufacturer is that of agricultural machines and farm machinery in general —pumps, motors and tractors. When the French manufacturer of *machines agricoles* goes out after business on a large scale some American firms will have sharp competition. The best off will be those who are already manufacturing in France, as, in the first instance, the International Harvester Co. at Lille, or again, in a not too remote example, the Wellman Morgan-Seaver interests in their line in association with the Schneiders at Creusot, the "Delco" combination at Nancy, or for that matter the Kodak concern, the typewriter companies the soap makers and the patent medicine manufacturers.

Working With the French

All of these have found out that conditions imposed upon them when they manufactured solely abroad were daily piling up in an almost impenetrable barrier and that the way to get a fair chance at the French market in these days was to manufacture on the spot, either wholly on their own account or in association with some French going concern which had facilities to offer and showed possibilities of expansion. In this way are annulled the effect of low production costs in France against a product manufactured in the United States in the first instance, then the elimination of customs' dues and the handicap brought about by the inconstancy of dollar and franc exchange, which latter is no myth and will probably continue to exhibit its mercurial tendencies for years.

Machine Tool Men in Japan Safe

Arthur Jackson, representative for the Potter & Johnston Machine Co., Pawtucket, R. I., in Tokio, Japan, reports that he and his wife are both safe, but after many harrowing experiences in the earthquake that recently damaged Tokio and Yokohama. Mr. Jackson also states in a recent letter to the *American Machinist* that Jay W. Myers, representative of the National Acme Co. in Japan, is also safe.

That Japan is in a distressing condition and that it has experienced and is experiencing extreme hardships are shown by the following excerpt from Mr. Jackson's letter:

"I was in our agents' office, the Yamatake Co. of Tokio at the time of the quake. The building did not fall, but nearly all the buildings around did and fires started immediately so it is very doubtful if it is saved.

"I helped in rescue work for two hours and then started to walk to my home in Yokohama. I passed the office of the Andrews & George Co. which was still standing, but the fires were creeping toward it.

"I passed the following engineering works which were down or on fire: Shibaura Engineering Co., Oki Denki, Nippon Electric Co. all of Tokio. Tokio Gas & Electric Co. of Omori, Niigata Ironworks of Kamata, Nipponophone Co., Tokio Electric Co., Kanagafugi Mill, all of Kakasaki, Asano Dockyard of Tsurumi, Yokohama Dockyard and every factory in Yokohama.

"The Yokosuka Naval Arsenal is also entirely destroyed. There were large oil tanks on the hills above the town of Yokosuka, all of which caught fire and sent streams of fire into the town and Dockyard.

"The loss of life is enormous as many were caught in factories or in homes and there was no chance of escape. Thousands got caught in the rivers of burning oil that came from the oil stores of the large oil companies that were burning.

"I had many narrow escapes from falling buildings or of being roasted alive, but I managed to get through it all and found my wife quite safe, except for a few bruises, in a field near what was left of our home, at three o'clock the next morning.

We walked through the ruins of Yokohama the next day and got picked up by a boat from the Steel Navigator. We stayed on her decks all that night and transferred to the President Jefferson the next day.

"We were also very pleased to meet Mr. and Mrs. R. Kimbara on board ship both unhurt. Mr. Kimbara is a partner of the Yamatake Co.

"Japan will be in the market for every type of machine tool, especially if it is decided to rebuild the devastated area. It is very doubtful if Yokohama will ever be rebuilt again. It seems as though the factories in the Osaka, Kyoto and Kobe districts will have a busy time ahead of them. They are out of the earthquake zone."

American Papers at Foundry Congress

The French Association Technique de Fonderie, on Sept. 12, organized its first international foundry congress in the Paris Ecole des Arts et Metiers, the opening session being presided over by Monsieur Gaston Vidal, Under Secretary of State and a member of the French cabinet.

Among the delegates present were the president of the American Foundrymens' Association; Mr. Stubbs of the Institute of British Foundrymen; Monsieur Leonard, president of the Association Technique de Fonderie de Liege —Belgium; Piesek, president of the Czecho-Slovakian Foundry Association; Signor Vanezetti—Italian, and Senor Espana of the Spanish Foundry Association, of which there were present at the congress and exposition 146 members.

The inviting French association was represented officially by Monsieur Emile Ramas, its president, who last year at the American Foundrymens' Association was present as the guest of his American colleagues.

M. R. Moldenke, from United States, presented a paper on the question of casting specifications, which paper brought forth a direct discussion with a French authority, Monsieur Portevin, who declared that there were really two problems involved therein, one which concerned the composition and quality of pig iron and that which concerned the same details with respect to merchant castings which were made from a previously manipulated semi-raw material, arguing that a change might supervene in the process and that actually a satisfactory pig iron from the point of view of analysis might produce an unsatisfactory line of castings in the second operation.

Monsieur Galley, a founder of Charleville in the French Ardennes submitted a paper on "The Application of American Methods for the Production of Malleable Iron."

The congress closed with the traditional banquet at which Monsieur Gaston Vidal, speaking in the name of the French government, addressed the foreign delegates.

A paper was submitted by H. M. Lane of the H. M. Lane Co., Detroit, on the "Equipment and Arrangement of the American Foundry." The French government announced to the president of the congress that it was about to establish a College of Foundry Practice as an adjunct of the high school system of Paris.

Safety Congress Is Held in Buffalo

Many interesting sessions and group meetings were held at the twelfth annual Safety Congress, Statler Hotel, Buffalo, N. Y., Oct. 1 to 5, and many exceptionally fine papers were read by authorities from all parts of the country. A great many subjects were treated, and due to the many phases of the safety problem, it was found that the only feasible way was to divide and subdivide into various sections of specific interest. Thus there were the following sections; automotive, chemical, cement, construction, education, electric railway, engineering, ice and refrigeration, marine, metals, mining, packers' and tanners', paper and pulp, petroleum, public safety, public utilities, rubber, steam railroad, taxicab and delivery, textile, and woodworking.

E. F. Blank, safety director of the Buick Motor Co., Flint, Mich., acted as chairman of the automotive section and discussions on punch press safeguarding, forging hazards, supervision and safety, the value of accident statistics on the standard basis, and eye injuries were participated in.

Handling materials in a foundry was the subject of an interesting discussion in the metals section which was presided over by T. H. McKenney, superintendent of labor and safety for the Illinois Steel Co., Chicago. Safety, fire protection, and the medical situation in large plants were other discussions.

E. Ross Farra of the American Car & Foundry Co., Wilmington, Del., had charge of an interesting round table discussion on the problems in woodworking machine safeguarding in the woodworking section of the meeting. Another interesting phase of the industry was the round table discussion on training machine operators in safe methods. This was led by M. C. Goodspeed, the General Electric Co., Erie, Pa.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Automobile accessories and supplies. Vigo, Spain. Purchase and agency. Reference No. 7840.

Automobile accessories and component parts for low priced cars. London, Eng. Exclusive agency. Reference No. 7807.

Copper rock ore concentrating machinery. Santo Domingo, Dominican Republic. Purchase. Reference No. 7803.

Diesel or semi-Diesel engines, 75 and 350 hp. San Pedro Sula, Honduras. Purchase. Reference No. 7804.

Lead pipe manufacturing machinery and accessories. Lapaz, Bolivia. Purchase. Reference No. 7843.

Tool machinery. Stockholm, Sweden. Purchase. Reference No. 7862.

Cutting and gouging woodworking tools. Marseille, France. Agency. Reference No. 7868.

Forthcoming Meetings

American Society for Steel Treating. Annual convention at Pittsburgh in connection with the International Steel Exposition, Oct. 8, 9, 10, 11 and 12. W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio, national secretary.

American Welding Society. Fall meeting, Oct. 24, 25 and 26. Fort Pitt Hotel, Pittsburgh, Pa.

Society of Automotive Engineers. Production meeting at Cleveland, Ohio, Oct. 25 and 26. Headquarters, 29 West 39th St., New York City.

American Gear Manufacturers Association. Fall meeting. Mountain House, Lake Mohonk, N. Y. Oct. 25, 26 and 27. T. W. Owen, secretary, 2,443 Prospect Ave., Cleveland, Ohio.

American Management Association. October 29, 30, and 31. Hotel Astor, New York City.

National Exposition of Power and Mechanical Engineering. Second annual exposition to be held at the Grand Central Palace, New York City, Dec. 3 to 8. Headquarters, Grand Central Palace, New York City.

New and Enlarged Shops

Machine Tools Wanted

Ill., Chicago—Apex Co., 1410 West 59th St.—three Leland & Gifford 12 in. single spindle high speed drills.

Ill., Chicago — Illinois Central R.R., 135 East 11th Pl., J. J. Bennett, Purch. Agt.—one 20 in. x 10 ft. heavy duty engine lathe, including motor for 440 volt, 50 cycle, 3 phase, a.c.

Mich., Detroit — Mohler Eng. Co., c/o Simons Sales Co., 436 West Willis Ave.—2, 3 or 4 spindle drill press.

Mo., Eldon—City Garage, E. E. MacMeans—lathe for garage.

Mo., Eldon—J. W. Dunaway—drill press and lathe for blacksmith shop.

Mo., Eldon—E. White—drill press and lathe for garage.

Mo., Henley—J. Klug (blacksmith)—drill press, lathe and tire shrinker (used).

Mo., Jefferson City—E. Petty, Main St.—lathe for garage.

N. Y., Brooklyn—Shyer Bros., 823 Flushing Ave., A. Shyer, Purch. Agt.—20 ton press for automobile repair shop.

N. Y., Elmira—E. E. Kunzman, 756 Baldwin St.—garage and service station equipment.

N. Y., New York—Buell Boxman, Inc., 467 Eway.—plain milling machine with dividing head and vise.

O., Columbus—Amer. Water Motor Co., 796 East 11th Ave. (manufacturer of automobile parts, etc.), L. Lewis, Pres.—two quarter cable lathes and two drill presses.

O., Columbus—Thurman Machine Co., 53 East Lafayette St., W. M. Thurman, proprietor—general machine tools, including one small lathe and one grinder.

Tex., Dallas—Amer. Body Co., 2802 Williams St.—one 7 or 8 in. moulder and a boring machine.

W. Va., Anawalt—Jeanette Garage Co.—lathe, drill press and bench tools.

Wis., Clintonville—Four Wheel Drive Co.—equipment, small tools and metal working machinery for the manufacture of earth boring machines, mounted on trucks.

Wis., Madison — Auto Service Co., 213 East Washington Ave., D. Bilaic, proprietor—automobile repair machinery, gasoline tanks and pumps for proposed $40,000 garage.

Wis., Madison—L. F. Schoelkopf Co., 210 East Washington Ave.—automobile repair machinery, drill press, compressor, shop equipment and small tools.

Wis., Milwaukee—Everhold Co., c/o A. J. Engelhardt, 1413 1st Natl. Bank Bldg., (manufacturer of specialties)—miscellaneous machine tools, including lathe, emery grinders, drill press and buffer.

Wis., Milwaukee—T. Kattnig, 281 Grove St. (machinist)—medium size drill press, electrically driven.

Wis., Milwaukee—Wacho Mfg. Co., c/o I. T. Touhey, 198 West Water St.—bending rolls and seaming machine for the manufacture of milk cans.

Wis., Neillsville—O. Lerverenz—automobile repair machinery, drill press, gasoline tanks and pumps for proposed $40,000 garage and filling station.

Wis., Oshkosh—Pine-Ihrig Co., 36 Marion St., E. W. Ihrig, Secy.—miscellaneous tools, press, etc., for the manufacture of electric washing machines.

Wis., Waukesha—Glancy Malleable Corp.—foundry equipment, presses, hammers and shop equipment for plant at Janesville.

Ont., Almonte—Lemaistre, Son & King, Water St., A. King, Purch. Agt.—equipment for garage and repair shop.

Ont., Lancaster—D. J. Parisien—tool grinder, etc., for garage.

Ont., Russell—D. A. McArthur—lathe for garage.

Que., Montreal—Auto Export & Supply Co., Ltd., 503 St. Urbain St.—lathe, bench tools, chain hoist, etc., for new garage at 1171 Carrieres St.

Que., St. Eustache—F. Brunnelle—tool room lathe for garage.

Que., St. Henri de Levis—A. Mercier—automobile repair machinery.

Que., St. Jerome—E. Girout—grinding machine for garage.

Que., St. Jovite—P. E. Grenor—drill press for garage.

Machinery Wanted

Ark., Mariana—Mariana-Courier Index—newspaper cylinder press.

Fla., Miami—Polar Water Co., 1702 North Miami Ave.—machinery for the manufacture of ginger ale.

Ind., Connersville—Bd. Educ.—manual training equipment, including lathes, cutters, woodworking machinery, etc., for new $250,000 high school.

Ind., Evansville — North Star Coal Co., 301 Amer. Trust Bldg.—coal mining machinery, conveyors, etc.

Ind., Gary—Leonard Tractor Co.—planer.

Ia., Des Moines—J. Hanson, 600 East Market St.—vulcanizing machinery.

Ky., Dawsonsprings — Dawson Daylight Coal Co.—coal tipple, crushing outfit and loading booms for opening new coal lands. Estimated cost $30,000.

Ky., Louisville—Office of United States Engineer, P. O. Box 72—one 6,500 lb. steam pile hammer; chain block, 1 ton capacity; bench punch; three machinists' vises, various sizes.

Md., Oakland—Victory Mining Co., G. S. Hamill, Purch. Agt.—machinery and equipment, including tipple machinery, for coal field development.

Mich., Highland Park (Detroit P. O.)—Ford Motor Co.—complete equipment for proposed assembly plant at St. Paul, Minn.

Minn., St. Hilaire—Spectator—adjustable punch, also lead and rule cutter.

Mo., Eldon—O. O. Clark—belt sander, Universal saw and finisher for planing mill.

Mo., Eldon—Eldon Advertiser (newspaper and job printer)—punch, Miller saw and trimmer (used).

Mo., St. Louis—H. J. Gunn, 4485 Delmar Blvd.—two oil pumps, tanks, compressed air outfits, etc., for oil filling and service station.

Mo., St. Louis—T. H. Voelkerding, 4908 Terry Ave.—two 1,000 gal. underground tanks and pumps, also compressed air tanks and miscellaneous equipment for oil filling and service station.

N. Y., Batavia—T. E. Donovan—refrigeration machinery and equipment for cold storage plant at Elba.

N. Y., Binghamton—Nestles Food Co.—special machinery for proposed $45,000 powdered milk plant at Valders, Wis., to replace that which was destroyed by fire.

N. Y., Buffalo—Buffalo Waste Paper Co., 98 Terrace St.— baling machinery for waste paper plant at 355 Babcock St.

N. Y., Buffalo—W. Maltby, 21 Maryland St. (oil producer)—one belt driven compressor, about 30 cu.ft. capacity.

N. Y., Elmira—Elmira Coca-cola Bottling Wks., 415 West 2nd St., E. T. Grove, Purch. Agt.—equipment.

N. Y., New York—F. Hawley, 244 West 42nd St.—jig or bandsaw, motor driven.

N. Y., New York—New York Mchy. Co., 200 5th Ave.—threading and cutting machine for 10 in. pipe.

N. Y., Perrysburg—Wells Grist Mill, E. Wells, Purch. Agt.—complete machinery and equipment, to replace that which was destroyed by fire.

N. Y., Rochester—Wick & Bedier, 29 North Plymouth St.—two gasoline curb pumps and tanks for garage and service station.

N. C., Hickory—Hickory Lace Braiding Co.—braiders, reelers, tippers and pairers.

O., Bryan—Pet Garment Co., W. Gardner, Purch. Agt.—machinery for proposed branch plant at Montpelier.

O., Cambridge—Cambridge Steel Products Co.—straightening machine for light rails up to 40 lbs.

O., Canton—Capital Paint & Varnish Co.—machinery and equipment for branch plant at Butler, Pa.

O., Cardington—K. S. Baskin—woodworking machinery, two cutoff saws, one planer and drying equipment.

O., Columbus—Brandt & Hollerbaugh, 180 North High St., H. S. Brandt, Mgr.—complete machinery, including mixer, dryer, shafting, etc., for stucco plant, to replace that which was destroyed by fire.

O., Columbus—City Ice & Fuel Co., 5th and Naghten Sts., C. M. Rose, Purch. Agt.—ice making equipment, also loading equipment for coal yard.

O., Columbus—Green Lawn Gravel Co., 315 North 4th St., H. R. Gill, Mgr.—loading tipple, screens and steam shovel.

O., Columbus — Maple Grove Coal Co., 2269 Cleveland Ave., E. C. Riley, Mgr.—mine scales.

O., Hubbard—Amer. Sintering Co.—machinery and equipment, including furnaces, for $200,000 addition.

O., Toledo—Swan Creek Lumber & Supply Co., Park Ave., K. Aschbacher, Purch. Agt.—four coal storage tanks, unloading equipment, automatic conveyors, etc.

O., Warren—Phillips-Custom Co., F. M. Phillips, Purch. Agt.—machinery and equipment for plant for the manufacture of automobile bodies.

Pa., Bally—Bally Burial Casket Co.—machinery and drying equipment, to replace that which was destroyed by fire.

Pa., Phila. — Campbell Constr. Co., 910 North Front St., S. Campbell, Purch. Agt.—one arm sander or disk sander for planing mill.

Tenn., Knoxville—Duncan Mchy. Co., Dempster Bldg., 721 North Central Ave., J. G. Duncan, Purch. Agt.—24 in. double surfacer; planer and matcher (used); automatic saw sharpener for gumming and sharpening circular saws up to 64 in. diameter.

Tex., El Paso—Tri-State Lumber Co.—ice making machinery.

Va., Ashland—D. R. Peregoy, R. F. D. 2 (sheet metal worker)—cornice brake, tools and machinery.

Va., Graham—Pocahontas Coal Land Corp., C. L. Shuffleburg, Secy.—loading and unloading equipment, conveyors, tipple machinery, etc.

Va., Richmond — Hackley Morrison Co., 1708 Lewis St.—one 10 or 12 hp. single cylinder single friction drum electric hoist, 3 phase, 60 cycle, 220 or 240 volt; well drilling machine; six standard gage side dump cars, 6 to 12 yd. capacity.

W. Va., Fairmont—Monongah Glass Co.—machinery to enlarge output, also machinery and equipment for 700 acre coal property.

W. Va., Wheeling—Wheeling Steel Corp.—conveyors, loaders, stone crushers, etc., for development of limestone deposit.

Wis., Algoma—Algoma Wood Products Co.—woodworking machinery for proposed $50,000 factory.

Wis., Berlin—Bd. Educ., P. Talbot, Pres.—ash conveyor and ash handling machinery for high school building.

Wis., Cuba — New Mills Constr. Co.—equipment, conveyors, etc., for new lead and zinc mine.

Wis., Hartford—I. L. Bonniwell—dairy machinery, churns, sterilizers, testers, belting and shafting for proposed $40,000 creamery.

Wis., Kohler—Kohler Co. (manufacturer of plumbing fixtures), c/o A. Treich, Supt. of Constr.—enameling equipment and furnace for proposed $50,000 shop.

Wis., Madison—Roxana Petroleum Co., 119 East Washington Ave., C. F. Ellis, Purch. Agt.—several 100,000 gal. gasoline tanks and pumps for station on East Main St.

Wis., Madison — Wisconsin Wagon Co., 115 South Blair St.—50,000 gal. gasoline storage tanks and pumps.

The Weekly Price Guide

RISE AND FALL OF THE MARKET

Iron and Steel—Pig-iron market weak with low prices and few buyers. New York steel warehouse orders increasing slightly over summer months. Steel and iron pipe in good demand. Bars firm at $2.40; plates and shapes, $2.50 per 100 lb., f.o.b. mill. Fewer inquiries for structurals at Pittsburgh. Drop in tank plate demand due to curtailment in crude oil output. Car specifications are more numerous but structural needs appear satisfied for the present time at least.

Advances—Tin higher; advanced 1¼c. in New York. Coke and charcoal plates higher in Cleveland. Linseed oil reviving from recent decline, in New York. Raw oil (5 bbl. lots) 98c., against 95c. per gal., last week. Decline, however, continues in Cleveland.

Declines—Copper more stable, but at level, ⅜c. lower than week ago. Lead and zinc quiet; zinc down ⅛c. per lb. in New York. Fabricated brass and copper lower in Cleveland warehouses. Reduction in both furnace and foundry coke at Connellsville.

IRON AND STEEL

PIG IRON — Per gross ton — Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$27.05
Northern Basic	25@26
Southern Ohio No. 2	25.50
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	30.00
BIRMINGHAM	
No. 2 Foundry	23.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	26.25
Virginia No. 2	30.17
Basic	26.00
Grey Forge	25.00
CHICAGO	
No. 2 Foundry local	26.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	29.01
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	26.77
Basic	26.77
Bessemer	27.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	6.75
Cleveland	6.75@7.40
Cincinnati	7.50
New York	5.50@7.00
Chicago	6.25@6.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York	Cleveland	Chicago
No. 10	3.00	4.59	3.75	4.15
No. 12	3.10	4.64	3.80	4.20
No. 14	3.20	4.69	3.85	4.25
No. 16	3.40	4.79	3.95	4.35
Black				
Nos. 17 and 21.	3.70	4.95	4.45	5.05
Nos. 22 and 24.	3.75	5.00	4.50	5.05
Nos. 25 and 26.	3.80	5.05	4.55	5.10
No. 28	3.85	5.15	4.65	5.20
Galvanized	**Pittsburgh**	**New York**	**Cleveland**	**Chicago**
Nos. 10 and 11.	4.00	5.15	4.70	5.35
Nos. 12 and 14.	4.10	5.25	4.80	5.45
Nos. 17 and 21.	4.40	5.55	5.10	5.75
Nos. 22 and 24.	4.55	5.70	5.25	5.90
No. 26	4.70	5.85	5.50	6.05
No. 28	5.00	6.15	5.80	6.35

WROUGHT PIPE (Welded)—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

Steel Inches	Black	Galv.	Iron Inches	Black	Galv.
		BUTT WELD			
1 to 3	62	50½	⅜ to 1¼	30	13
		LAP WELD			
2	55	43½	2	23	7
2½ to 6	59	47½	2½ to 4	28	13
7 and 8	56	43½	4½ to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			
		BUTT WELD, EXTRA STRONG, PLAIN ENDS			
1 to 1½	60	49½	⅜	28	12
2 and 3	61	50½	1 to 1½	30	14
		LAP WELD, EXTRA STRONG, PLAIN ENDS			
2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅛ to 3 in. steel butt welded	48%	34%	55½%	43½%	50%	37%
2½ to 6 in. steel lap welded	44%	30%	53½%	40½%	47%	34%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 15%. Cast iron, standard sizes, 17½% off.

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ½-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
½	$0.09	50%	⅞	$0.16	35%
⅝	.11	45%	1	.18	31%
¾	.14	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.20 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.50	6.00	4.50
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.53	8.00	6.55
Hoop steel	5.19	4.66	4.55
Cold rolled strip steel	7.50	8.25	7.25
Floor plates	5.80	5.66	5.80
Cold finished shafting or screw	4.65	3.90	4.55
Cold finished flats, squares	5.15	4.40	5.05
Structural shapes (base)	3.64	3.46	3.40
Soft steel bars (base)	3.54	3.36	3.20
Soft steel bar shapes (base)	3.54	3.36	3.20
Soft steel bands (base)	4.39	3.61	3.95
Tank plates (base)	3.64	3.46	3.30
Bar iron (3.25 at mill)	3.54	3.36	3.20
Tool steel	11.00	....	....
Drill rod (from list)	55%	40@55%	50%

Electric welding wire, New York, $\frac{5}{32}$, 8.35c.; $\frac{1}{8}$, 7.85c.; $\frac{5}{32}$ to $\frac{1}{4}$, 7.35c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			13.75
Tin, 5-ton lots, New York			43.50
Lead (up to carlots), St. Louis	6.70	New York	7.37½
Zinc (up to carlots), St. Louis	6.30	New York	6.70

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminum, 98 to 99% ingots, 1-15 ton lots	25.20	27.00	25 50
Antimony (Chinese), ton spot	8.75	10.50	7 50
Copper sheets, base	21.75	21.50@22.00	23 00
Copper wire, base	16.00	18.75	16 25
Copper bars, base	20.25	22.00	19.50
Copper tubing, base	24.50	27.00	23.00
Brass sheets, base	18 00	21.75	18.75
Brass tubing, base	23.00	27.00	20.50
Brass rods, base	15.75	17.75	15.75
Brass wire, base	18.50	21.75	.....
Zinc sheets (casks)	10.25	10.45	.....
Solder (½ and ½), (case lots)	29.50	29.00	20.00
Babbitt metal (83% tin)	52.00	53.50	40.00
Babbitt metal (35% tin)	25.00	17.50	17.00
Nickel (ingot and shot)	29.00	.....	35 00
Nickel (electrolytic)	32.00	.....	35.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb.

Malleable nickel sheet (base)	57.00
Hot rolled rods, Grade "A" (base)	55.00
Cold drawn rods, Grade "A" (base)	63.00
Copper nickel ingots	37.00
Hot rolled copper nickel rods (base)	45.00
Manganese nickel hot rolled rods "E"—low manganese (base)	57.00
Manganese nickel hot rolled rods "D"—high manganese (base)	60.00

Base price of monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	11.75	11.75	12.00
Copper, heavy, and wire	11.25	11.25	11.25
Copper, light, and bottoms	9.50	9.25	10.25
Lead, heavy	5.75	5.50	5 75
Lead, tea	4.75	4.25	4.75
Brass, heavy, yellow	7.00	....	7.25
Brass, heavy, red	9.50	9.50	9.00
Brass, light	5.50	5.25	6 50
No. 1 yellow brass turnings	6.50	6.00	7.00
Zinc	3.75	3.00	4.00

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	20x28, 112 sheets	$25.10	$22.85	$18.50
"A" Grade:				
IC,	20x28, 112 sheets	21.40	18.00	17.00
	Coke Plates—Primes, 20x28 in.			
100-lb.,	112 sheets	14.00	13.00	14.50
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	8.25	6.55	7 40

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.10@0.13	$0.15	$0.11
Cotton waste, colored, per lb.	.08@.13	.12	.08
Wiping cloths, 13½x13½, per lb.	11.00	36.00 per M	.10
Wiping cloths, 13½x20½, per lb.	....	52.00 per M	.13
Sal soda, per 100 lb.	1.65	2.25	2.65
Roll sulphur, per 100 lb	3.85	3.25	3.50
Linseed oil, per gal., 5 bbl. lots	.98	1.02	1.14
White lead, dry or in oil	100 lb. kegs.	New York,	14.00
Red lead, dry	100 lb. kegs.	New York,	14.00
Red lead, in oil	100 lb. kegs.	New York,	15.50
Fire clay, per 100 lb. bag		.65	.60
Coke, prompt furnace, Connellsville	per net ton	$4.00@4.50	
Coke, prompt foundry, Connellsville	per net ton	5.00@5.50	

SHOP SUPPLIES

Current Discounts from Standard Lists

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	40-10%	50-10%	45-5%
1⅛ and 1¼x3 in. up to 12 in.	15%	50%	50%
With cold punched hex. nuts up to 1 in. diam. (plus std. extra of 10%)	25-10%	$3.50 net	....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	30-10%	3.50 net	$4.00 off
Button head bolts, with hex. nuts	List net	List net	.....
Hex. head and hex. nut bolts	List net	.....	65-5%
Lag screws, coach screws	40-10%	.....	60-5%
Square and hex. head cap screws	60%	70%	70-10%
Carriage bolts, up to 1 in. x 30 in.	30-10%	45%	40-5%
Bolt ends, with hot pressed nuts	40-10%	.....	55%
Tap bolts, hex. head, list plus	35%	.....	.....
Semi-finished nuts, $\frac{5}{16}$ and smaller	60%	.....	....
Semi-finished nuts, ⅜ and larger	55%	65-10%	80%
Case-hardened nuts	40%	.....	.....
Washers, cast iron, ⅛ in., per 100 lb. (net)	$6.50	$4.00	$3.50
Washers, cast iron, ¼ in., per 100 lb. (net)	5.50	4.00	3 50
Washers, round plate, per 100 lb. Off list	1 50	4.00	3.50 net
Nuts, hot pressed, sq., per 100 lb. Off list	0.50	2.75	2.50
Nuts, hot pressed, hex., per 100 lb. Off list	0.50	2.75	2.50
Nuts, cold punched, sq., per 100 lb. Off list	0.50	2.75	2.50
Nuts, cold punched, hex., per 100 lb. Off list	0.50	2.75	2.50
Rivets:			
Rivets, $\frac{7}{16}$ in. dia. and smaller	50-10%	50-10%	60%
Rivets, tinned	50-10%	50-10%	4½c. net
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb (net)	$5.50	$3.90	$3.75
Cone heads, ditto (net)	5.60	4.00	3.85
1⅛ to 1¾-in. long, all diameters, *EXTRA* per 100 lb.	0.25	.....	0.15
⅜ in. diameter *EXTRA*	0.15	.....	0.15
½ in. diameter *EXTRA*	0.50	.....	0.50
1 in. long, and shorter *EXTRA*	0.50	.....	0.50
Longer than 5 in. *EXTRA*	0.25	.....	0.25
Less than 200 lb. *EXTRA*	0.50	.....	0.50
Countersunk heads *EXTRA*	0.35	.....	$3.70 base

	New York	Cleveland	Chicago
Lard cutting oil (50 gal. bbl.) per gal.	$0.55	$0.50	$0.67½
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	0.297	0.35	0.40
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 2c. per sq.in., per ply:			
Medium grade	30-10%	30-10%	30-10%
Heavy grade	20-5-2½	30%	20-5-2½%
Rubber and duck:			
First grade	50-10-5%	50-10%	40-10%
Second grade	60-5%	60-5%	60-5%
Abrasive materials—In sheets 9x11 in.,			
No. 1 grade, per ream of 480 sheets:			
Flint paper	$6.30	$5.84	$6.48
Emery paper	9.90	11.00	8.80
Emery cloth	31.12	31.12	29.48
Flint cloth, regular weight, width 3½ in., No. 1 grade, per 50 yd. roll.	4.73	4.28	4.95
Emery discs, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.24	1.40
Cloth	3 38	2.67	3.20

Wis., Marshfield—Hub Granite Co., c/o T. Harshner—power saws and planer for stone cutting.

Wis., Mayville—Mayville Improvement Corp., c/o A. D. Naber—shoe making machinery, cutters, etc., for proposed shoe factory.

Wis., Milwaukee—L. L. Albert, 628½ Oakland Ave.—emery wheel, stand, portable drilling machine and air service equipment for automobile repair shop.

Wis., Milwaukee—B. Gill, 1075 15th St.—laundry equipment, including mangle, extractor, drying outfit, belting and shafting.

Wis., Milwaukee—Gridley Dairy Co., 1329 North Ave.—engine driven ice machine for proposed addition to dairy.

Wis., Milwaukee — Lemm Electric Co., 3324 Fond du Lac Ave.—battery testing and charging equipment for proposed $40,000 service station.

Wis., Milwaukee—A. H. Luedecke, 140 8th St. (dairy products)—refrigeration machinery, about 30 ton, belt or motor driven.

Wis., Milwaukee—Roberts Brass Co., 178 Lincoln Ave., J. F. Howard, Purch. Agt.—moulding machines and buffing machine.

Wis., Neenah—Fox River Valley Co-operative Co.—refrigeration machinery and cold storage equipment for proposed cheese warehouse.

Wis., Neenah—J. W. Hewitt Machine Co., 131 North Commercial St.—special machinery for the manufacture of dies, etc.; hand operated traveling crane.

Wis., Oshkosh—Oshkosh Fuel Co., 239 F. R. A. Bldg. (sawmill), E. Moerke, Purch. Agt.—large circle saws, rip saw, belting, shafting and hangers.

Wis., Oshkosh—Oshkosh Wood Specialty Co., 416 7th St.—wood turning lathe.

Wis., Racine—Gold Medal Camp Furniture Co., 1700 Packard Ave.—tools and small equipment.

Ont., Amherstburg — Amherstburg Glass Co., A. A. Icenhour, Pres.—special equipment for the manufacture of glass by a new process.

Ont., Apple Hill—A. D. Clingen—bandsaw, etc.

Ont., Belton—H. Jones—complete equipment for proposed creamery and cheese factory at Thorndale.

Ont., Blenheim—S. B. Nichol, John St.—equipment for proposed $38,000 planing mill.

Ont., Dundas — Kaustine Co. (manufacturer of chemical closets and plumbing specialties), J. F. Crowley, Mgr.—machinery for proposed addition to factory.

Ont., Eganville—Schulrink & Smith, John St.—emery grinder, etc., for garage.

Ont., Guelph—Malt Products Co., Waterloo Ave.—special equipment, to replace that which was destroyed by fire.

Ont., Krugersdorf—Tesserton Timber Co.—equipment for sawmill, to replace that which was destroyed by fire.

Ont., Larder Lake — Blue Quartz Gold Mines, Ltd., J. F. Louden, Purch. Agt.—mill.

Ont., Lion's Head—J. H. Cook representing syndicate—equipment for oil drilling at Spry.

Ont., London—S. Jones, 374 Tecumseh Ave.—complete equipment for proposed $40,000 plant for the manufacture of mastic flooring.

Ont., London—Silverwoods, Ltd., A. E. Silverwood, Mgr.—cold storage plant, also equipment for the manufacture of ice cream for branch at Lucknow.

Ont., Madawaska — O. McCrea — small grinder, etc., for garage.

Ont., Midland—International Fibre Board Co.—machinery and equipment.

Ont., Morrisburg—W. Roach, Main St.—air compressor, tank and pump for garage.

Ont., Russell—H. Miller—bench tools, emery wheel and stand for garage.

Ont., Russell—A. Walker—machinery for planing mill.

Ont., St. Eugene—G. N. Lerout—panel raiser for sash and door factory.

Ont., Simcoe — Stacey-Wagner Leather Co.—Union splitting machine; rolling jack; small tools, including knives, etc.; 1⅞ in. shafting with hangers and pulleys.

Ont., Walkerville—Berry Bros., Inc., Walker Rd.—equipment to enlarge paint and varnish factory.

Que., Campbell's Bay—E. Laforest—forge, small tools, etc., for blacksmith shop.

Que., Matane—Price Bros. Co., Ltd., A. E. Tweedell, Mgr.—circular and bandsaws.

Que., Montreal—A. Brisebois, 6150 De St. Real St.—forge, bench tools, etc., for new blacksmith shop.

Que., Montreal—L. Desrosiers, 182 Hadley St.—gasoline tank, pump and air compressor for new shop at 178 Hadley St.

Que., Montreal—C. Plouffe, 1906 St. Denis St.—chain hoist, small lathe, emery wheel, etc., for new automobile repair shop at 532 De St. Valier St.

Que., St. Agathe—E. Maille (blacksmith and wheelwright)—forge, chain hoist and equipment for carriage repairs.

Que., St. Francois de Salle—Montreal Cut Stone, Ltd.—equipment.

Que., St. Jerome—E. Meunier—dowel machine and other equipment for sash and door factory.

Que., St. Narcisse—E. Gagnon (sawmill)—rip saw, swing saw, etc.

Que., St. Placide—J. P. Lefebvre & Fils—foundry equipment.

Que., St. Scholastique—I. B. Tarsie & Co.—foundry equipment.

Que., St. Therese de Blainville—Charron & Freres—mortiser, dovetailer, etc., for sash and door factory.

Nfld., St. Johns—Parson's Pond Oil Co., Ltd., J. D. Henry, Purch. Agt.—drilling machinery and equipment for oil field.

Nfld., St. Johns—St. George's Coal Fields, Ltd., J. T. Freeman, Dir.—mining machinery and equipment for coal fields.

Metal Working Shops

Calif., Long Beach—C. Bellows, 30 Locust St., is having plans prepared for the construction of a 2 story, 125 x 175 ft. garage and salesrooms on American Ave. and 20th St. Austin Co. of California, Bartlett Bldg., Los Angeles, Archts.

Calif., Los Angeles—A. Costello awarded the contract for the construction of a 4 story, 72 x 200 ft. garage at 1348 South Figuroa St. Estimated cost $129,000.

Calif., Los Angeles—D. E. Foster, 1259 Maryland St., is having plans prepared for the construction of a 2 story, 65 x 140 ft. garage. Private plans.

Calif., Los Angeles—The Los Angeles Motor Bus Co., 806 Railway Bldg., awarded the contract for the construction of a 1 and 2 story garage and office building on North Virgil St. Estimated cost $115,000. Noted Sept. 13.

Calif., Oakland — The Chevrolet Motor Co. of California, Foothill Blvd. and 69th Ave., awarded the contract for the construction of a 1 story addition to its factory. Cost will exceed $150,000. Noted Sept. 13.

Calif., San Francisco—The Otis Elevator Co., 2300 Stockton St., awarded the contract for the construction of a 2 story shop and office building on Beach St. and Grant Ave. Estimated cost $350,000. Noted Oct. 4.

Calif., Vernon—The California Metal Enameling Co., East 51st St., is having plans prepared for the construction of a 1 story, 50 x 120 ft. and 60 x 75 ft. addition to its plant. Estimated cost $40,000. Hamm & Grant, Inc., Ferguson Bldg., Los Angeles, Engr.

Ia., Dubuque — Koenigsberg & Weisfeld, Archts., 155 North Clark St., Chicago, are receiving bids for the construction of a 3 story, 100 x 103 ft. automobile sales and service station, for the Balsky Motor Co., 6th and Iowa Sts., here. Estimated cost $200,000.

Wis., Kohler—The Kohler Co., c/o A. Treich, Supt., is receiving bids for the construction of a 1 story, 67 x 210 ft. enameling shop. Estimated cost $60,000. Private plans.

Wis., Madison—The Auto Service Co., 213 East Washington Ave., is receiving bids for the construction of a 1 story, 50 x 90 ft. garage and repair shop. Estimated cost $40,000. D. Bilaic, proprietor. Private plans.

Wis., Madison — The Madison Medical Assn., c/o R. S. Ingersoll, Lakeside St., plans to build a 2 story, 45 x 100 ft. garage, boiler house and laundry. Estimated cost $50,000. Engineer or architect not selected.

Wis., Markesan—W. Dehn is having plans prepared for the construction of a 1 story, 50 x 90 ft. garage and repair shop. Estimated cost $40,000. Private plans.

Wis., Milwaukee—The Hoyer Eng. Co., 281 Grove St., plans to build a 1 story, 60 x 100 ft. machine shop. Estimated cost $40,000. Engineer or architect not selected.

Wis., Milwaukee—The Lemm Electric Co., 3324 Fond du Lac Ave., awarded the contract for the construction of a 2 story, 34 x 80 ft. battery service station. Estimated cost $40,000.

Wis., New Lisbon—F. J. Bunker plans to build a 2 story garage and repair shop. Estimated cost $40,000. Engineer or architect not selected.

Wis., North Milwaukee—W. P. Schwartzburg, 43rd St. and Hammond Ave., awarded the contract for the construction of a 1 story, 60 x 100 ft. garage on Villard Ave. Estimated cost $40,000.

Wis., Portage—E. Weinke awarded the contract for the construction of a 2 story, 50 x 70 ft. garage and repair shop. Estimated cost $40,000. Noted Aug. 23.

Wis., Spring Valley—The Pierce Auto Co. is having plans prepared for the construction of a 1 story, 50 x 75 ft. garage and repair shop. Estimated cost $40,000. C. W. Pierce, Mgr. J. M. Kotts, Spring Valley, Archt.

Ont., Dundas—The Kaustine Co., manufacturer of chemical closets and plumbing specialties, plans to build a 60 x 120 ft. addition to its factory. Estimated cost $30,000. J. F. Crowley, Mgr.

Ont., Eastview—The Musical Clock Co. plans to build a 2 story, 50 x 100 ft. factory. Estimated cost $30,000. Engineer or architect not selected.

Ont., Ridgetown—E. Fysh plans to build a garage, automobile repair shop and service station. Estimated cost $40,000.

Ont., Welland—W. G. Somerville & Son, 36 Main St., North, awarded the contract for the construction of a 1 story, 52 x 100 ft. garage, automobile, tire and battery repair shop. Estimated cost $50,000.

Reaa the

SEARCHLIGHT SECTION

the "Opportunity" Advertising of the Machinery Field

See pages 109 to 121